MACHINE DESIGN

PARTS • MATERIALS • METHODS • FINISHES

THE PROFESSIONAL JOURNAL OF CHIEF ENGINEERS AND DESIGNERS

Volume 9 SEPTEMBER 1937 Number 9

EDITORIAL STAFF

Editor
L. E. JERMY

Associate Editors
Guy Hubbard
Fred Kelly
F. H. Burgess

New York . . . . . B. K. Price
Chicago . . . . . W. G. Gude
Pittsburgh . . . . . D. R. James
Detroit . . . . . A. H. Allen
Washington . . . . . L. M. Lamm
London . . . . Vincent Delport

BUSINESS STAFF

New York
J. F. Ahrens, *Eastern Mgr*
Russell H. Smith

Chicago
H. H. Dreyer, *Western Mgr.*

Cleveland
H. B. Veith, *Central-Western Mgr.*

Published Monthly by
THE PENTON PUBLISHING CO.
Penton Building, Cleveland, Ohio

John A. Penton . *Chairman of Board*
E. L. Shaner . *President and Treasurer*
J. R. Dawley . . . *Vice President*
G. O. Hays . . . *Vice President*
F G. Steinebach . *Secretary*

BRANCH OFFICES

New York . . . . 220 Broadway
Chicago . . Peoples Gas Building
Pittsburgh . 1650 Koppers Building
Detroit . . 1010 Stephenson Building
Washington . National Press Building
London . . Caxton House, Westminster, S. W. 1

CONTENTS

Page

Many Obstacles Beset Path of Technical Progress . . . 31
By Bernhard J. Stern

Scanning the Field for Ideas 35

Machine Life Is Increased with Air Filters 37
By Fred Kelly

Foundry Machine Departs from Tradition 42

Location of Noise Source Is Scientific Study 43
By C. W. LaPierre

Three Machines Built into One! 47

Compactness Is Primary Quality of Needle Roller Bearings . . 48
By Guy Hubbard

Design Features in New Machines 52

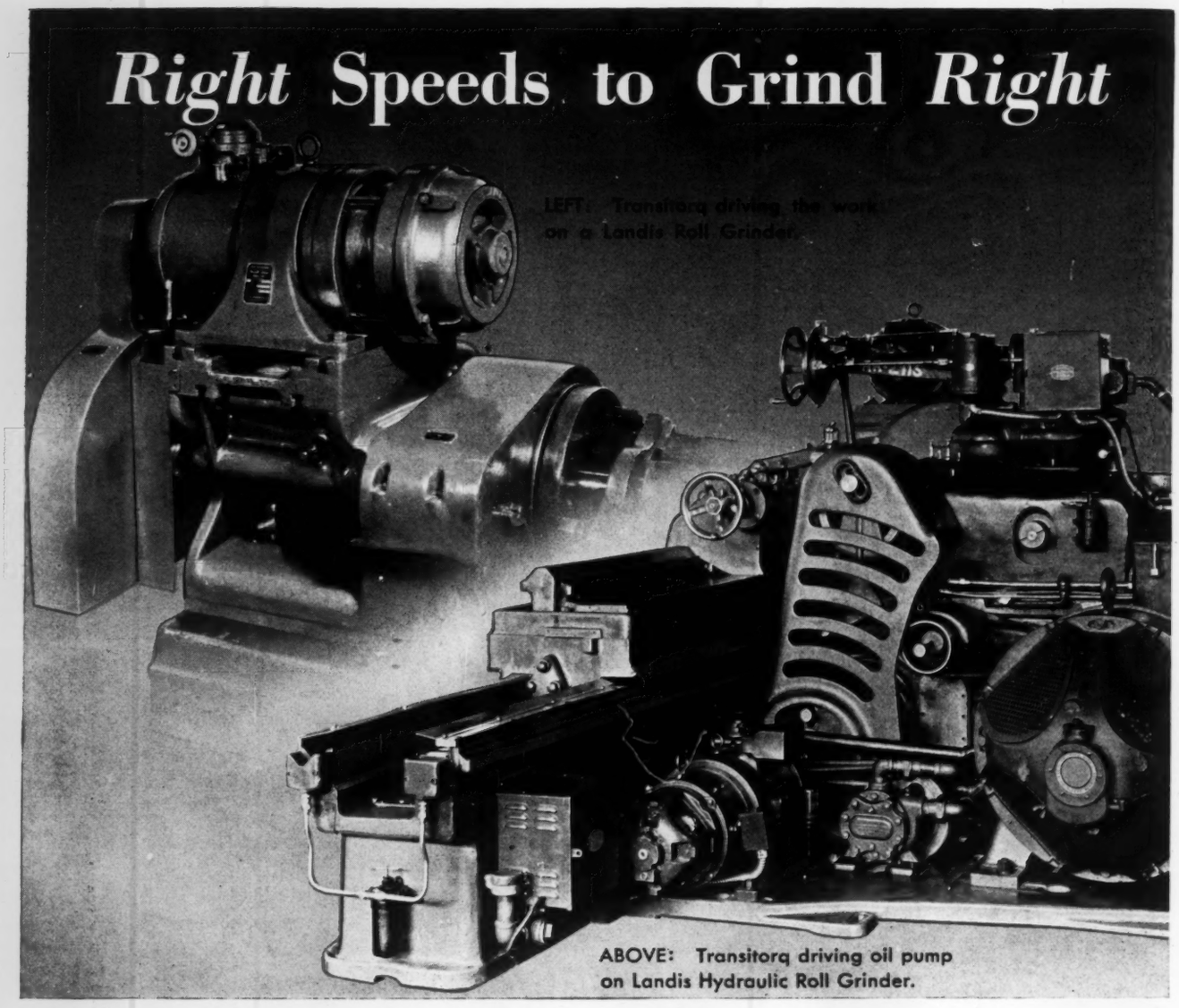
New Machines Indicate Design Trends 54

Cut-and-Try Methods Should Be Supplemented by New Design Equipment (Editorial) 55

Men of Machines 56
Noteworthy Patents 60
New Materials and Parts 66
Calendar of Meetings 86
Manufacturers Publications 94
Business Announcements 98
Topics 28

MACHINE DESIGN is published on the tenth of each month. Subscription rates: United States and possessions, Canada, Cuba and Mexico, two years $5; one year $3. Single copies 35 cents. Great Britain and other European countries, one year $5. **Copyright, 1937, by The Penton Publishing Co.** **Acceptance under act of June 5, 1934, authorized July 20, 1934.**

Right Speeds to Grind *Right*



LEFT: Transitorq driving the work on a Landis Roll Grinder.

ABOVE: Transitorq driving oil pump on Landis Hydraulic Roll Grinder.

• No matter what the diameter of the work or nature of the material to be ground, Transitorq makes it possible to select exactly the *right* speed for the *best* finish. With this Landis Hydraulic Roll Grinder there is no such thing as approximation:—there are no *steps* in speed, because Transitorq is *infinitely adjustable,* either while stationary or grinding. At the touch of a finger the operator obtains the speed he wants. He is complete master of the job. Our engineers will be glad to show what Transitorq can do for your machines.

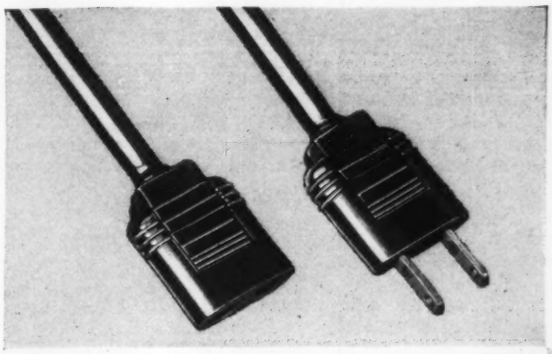
New Departure, Division General Motors Corporation, Bristol, Connecticut. Branch Offices at Chicago, Detroit and San Francisco.

NEW DEPARTURE
Variable Speed
TRANSITORQ

2594-P

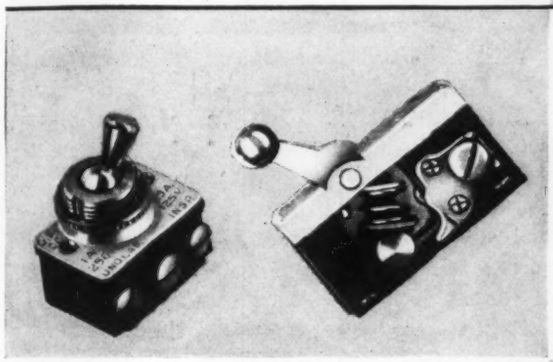
COMPLETE G-E ACCESSORY WIRING SERVICE

Increases the Reliability of Your Appliances



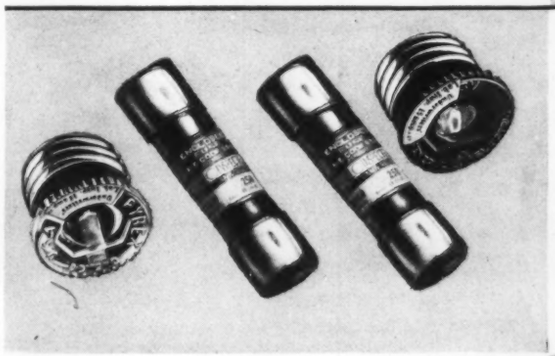
G-E All-rubber Cord Sets last the life time of your appliances. Plugs and connectors are molded on the cord. They are the only cord sets protected by bonded, homogeneous rubber insulation throughout . . . literally one piece of rubber from end to end.

★ **CONNECTION**



Such G-E Switches insure positive control of your appliances. They are available in skeleton or enclosed types in a wide range of ratings. These switches are small, compact . . . easy to assemble on production lines. They are designed to give long, reliable service.

★ **CONTROL**



These G-E Fuses with proper cutouts, afford maximum protection wherever it is required. They are made to the most rigid specifications and are accurately rated. G-E Fuses are available in all ratings. Either type will dependably protect your electrical appliances.

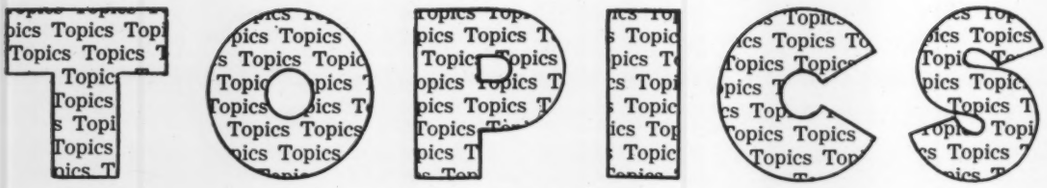
★ **PROTECTION**

SEND FOR DETAILED INFORMATION ON THIS COMPLETE G-E ACCESSORY EQUIPMENT WIRING SERVICE. WRITE SECTION Q-109, APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC CO., BRIDGEPORT, CONN.

GENERAL ELECTRIC

ACCESSORY EQUIPMENT

APPLIANCE AND MERCHANDISE DEPARTMENT, GENERAL ELECTRIC COMPANY, BRIDGEPORT, CONNECTICUT



Whether technological progress increases or decreases world harmony is a question. The benefits of mass travel brought about by cheap mechanical transportation are inducive to more pacific relations between the countries of the world. When one has had the opportunity to see and observe other peoples he is inclined to be tolerant. On the other hand, as pointed out by S. C. Gilfillan in Technological Trends and National Policy, "increasing contacts in some ways brings new frictions, as through radio propaganda, and the fear of airplane raids." "While invention modifies political practices, in turn political principles modify what will be done with inventions." Probably machines have a greater rather than less uniting effect throughout the world, but it is indisputable that in many instances they temporarily disrupt world stability.

♦ ♦ ♦

Capable of being brought to a white heat of 1800 degrees Fahr. without melting, aluminum coated steel has been introduced for practical consideration of the designer in place of tin-coated or galvanized steel. The process of aluminum-coating steel was developed about a year ago but it is only recently that commercial applications have been made which show the advantages of the material. This latest form of steel, according to Professor Colin G. Fink, head of Columbia's division of electrochemistry, who developed it, combines the high corrosion resistance of aluminum with the great tensile strength of steel. Machine parts subject to corrosion may be made of this aluminum-coated steel in smaller and lighter sections than formerly.

♦ ♦ ♦

Tracking down every sound emanating from an automobile engine is the job being done in a new acoustical laboratory of General Motors Corp. Two soundproof rooms with walls, floors and ceilings insulated from outside noise by layers of felt, concrete, air space and rockwool have been built and completely equipped for ferreting out unwanted noise. Air in the rooms is so still that it is said to be oppressive, just like the atmosphere before a storm, we suppose.

♦ ♦ ♦

Carnival stunts and practices which make up a large part of today's expositions do not hold a very strong appeal to the serious minded visitor, but technological exhibits are certainly being presented in praiseworthy fashion. Attempting to explain rather than awe the onlooker, these exhibits have done much to make mechanical principles understandable to the layman. Advance releases from the Golden Gate Exposition to be at San Francisco year after next and the New York World's Fair, Inc. which opens in 1939 indicate that machines, metals and industry in general will be well represented. Showmen are learning that commonplace things like washing machines and refrigerators can be made interesting to the average person if given the proper setting. Although we live in a machine age, it is not generally understood why and how most machines operate.

♦ ♦ ♦

In developing die-casting machines that would produce automobile radiator grilles or large castings without hidden flaws or cavities, engineers unknowingly made it possible for many small die-cast parts to be immeasurably improved. Many massive machines which were needed to make grilles are now being employed to cast door handles, carburetor parts, fuel pumps and fittings of perfect quality. The development of almost any type of machine assists in the design of others. Many which were originally built for one purpose are converted to do a job which might otherwise have gone undone.

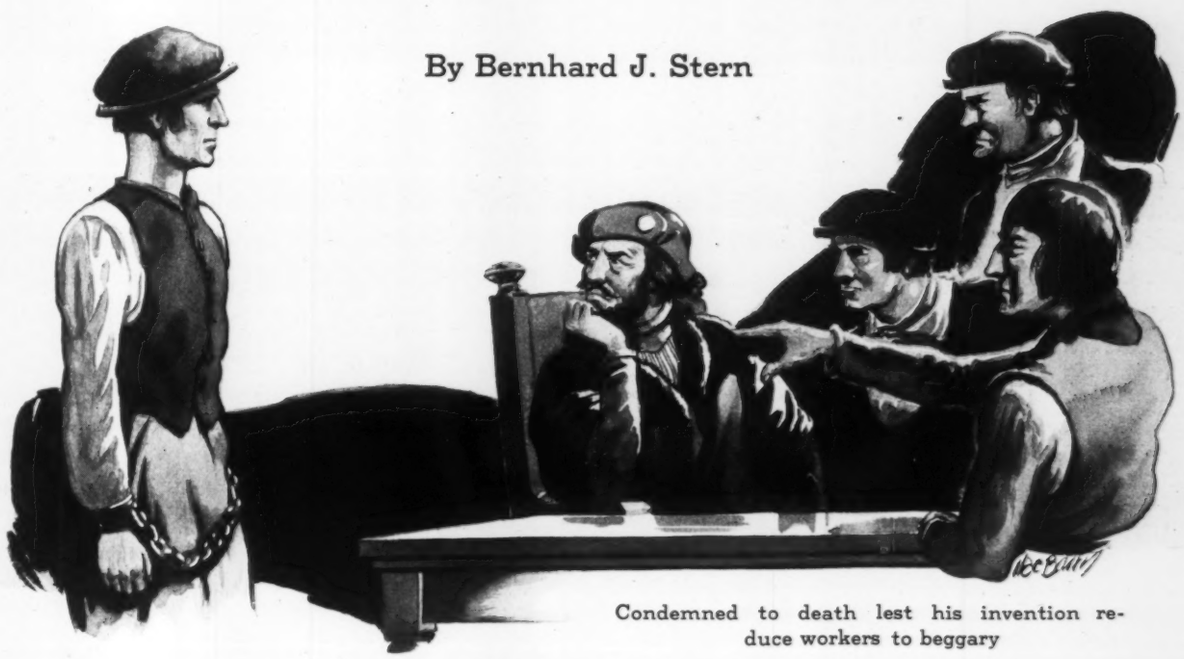
♦ ♦ ♦

It might seem to the uninformed that we are rapidly leaving the day of simplified transportation for faster and more luxurious accommodations, but we learn on unimpeachable authority that sales of bicycles in the United States for 1936 were greater than any year since 1899.

MACHINE DESIGN

Many Obstacles Beset Path of Technical Progress

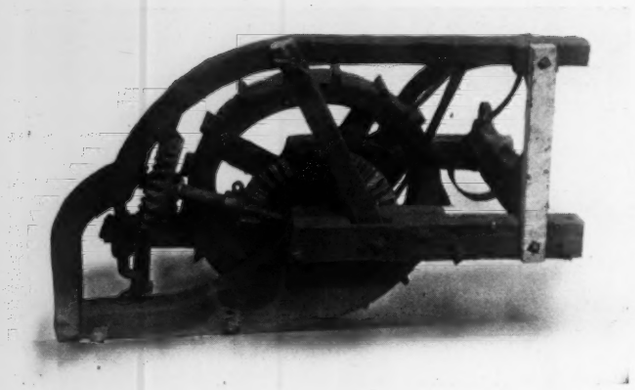
By Bernhard J. Stern



Condemned to death lest his invention reduce workers to beggary

FORECASTS can be made as to inventions in the offing through a knowledge of the cumulative developments and lines of research in specific fields. But such predictions are nonrealistic unless they take into consideration the social and economic setting of these innovations. Basic inventions may be still-born and entire lines of potential development be prevented, not because of deficiency in engineering plans, but because of factors entirely beyond their scope. Predictions based upon the assumption that if valuable technological inventions are but conceived, they will be incorporated into industrial life, ignore the evidence of past experience. For the history of inventions in technology is replete with frustrations and protracted delays in the acceptance of innovations which subsequently have proved of inestimable value to mankind.

The acceptance or rejection of technical innovations depends to a large measure on whether they are introduced at a time when an economy is static, contracting or expanding; whether they appear in a setting of social stratification, or anarchic competition and class struggle, or in a planned industrial order. Within these varied frameworks there are



Mower of this type was banned by bigoted persons who felt that leisure afforded by such a machine was evil

other psychological and cultural factors that determine receptivity to innovations which can be brought into perspective by a study of specific cases of opposition to technological change.

It is clearly to man's advantage to be able to traverse distances with facility and in ease, yet innovations permitting more comfortable and more rapid mobility generally have encountered apathy or overt resistance, and their utilization has repeatedly been restricted by vested interests. In the thirteenth century such resistance manifested itself in the case of the use of carriages. Philip the Fair ordered the wives of citizens of Paris not to ride in carriages in order to preserve the prerogatives of the ladies of the court. A law likewise sought to prevent the use of coaches in Hungary in 1523, and the Duke Julius of Brunswick in 1588 made riding in coaches by his vassals a crime punishable as a felony, largely on the grounds that it would interfere with military preparedness, for men would lose their equestrian skill.

Turnpike companies profiting by tolls, and owners of stagecoaches were among the most active opponents of railroads. They were supported by tavernkeepers along the route of the roads, and by farmers who felt that the introduction of the railroad would deprive them of markets for horses and for hay.

In England the resistance to the railroad was largely from the landlord class which, with its feudal privileges, arrayed itself against the aggressive industrial bourgeoisie.

In the United States likewise there was opposition to the railroad. It was argued that its use would: "introduce manufacturing into the heart of the country, divert industry from the primitive healthful and moral pursuits of agriculture, and bring on us the vices and miseries of manufacturing and commercial places." Many small towns joined the opposition, some on the grounds that their quiet would be interrupted by steam cars and the influx of strangers, others because business would be diverted to the larger cities.

Each improvement in railroad equipment and organization has been marked by opposition and delay especially when it involved costly equipment rendering the older stock obsolete. Commodore Vanderbilt dismissed Westinghouse and his new air brake with the remark that he had no time to waste on fools. When W. R. Sykes in 1874 presented plans for a system of automatic signalling on British railroads, the board of trade and the directorate of the railway companies maintained that personal care by signalmen was much better than any automatic system.

There were many precursors of the modern automobile that failed to survive the opposition and apathy of their times. A three-wheeled carriage driven by two steam cylinders was invented by Joseph Cugnot in 1769 which actually moved a load in addition to its own weight, but it did not succeed in capturing popular support. In England when William Murdock built a one-cylinder steam-driven vehicle about 1784, Watt, his employer, who opposed the use of steam engines for road transportation, discouraged him.

Horse Breeders Opposed Automobiles

In the 1860's it appeared that mechanical transportation had come to stay in England, but again the opposition of horse breeders and railroads stood in the way. They secured passage of an act of Parliament, in 1861, for the regulation of horseless vehicles which practically made it impossible for them to operate.

The automobile propelled by the internal-combustion engine made its way slowly against ignorance, apathy and competition. In 1890 and 1891 the Chicago World's Fair advertised universally for exhibits in "steam, electric, and other road vehicles propelled by other than animal power," but made no specific mention of the internal-combustion engine. One of the greatest sales obstacles the gasoline car had to overcome was the widespread conviction that Edison would invent a superior and cheaper electric automobile.

Changes in the automobile that would increase its

ALMOST insuperable obstacles have hampered the development and general acceptance of inventions yet machines today are responsible for our improved standard of living. That engineers who introduce technical improvements may not be discouraged, this article, giving some reasons for past antagonisms and apathy on the part of both workers and public, is presented. It is abstracted from "Technological Trends and National Policy" prepared by the President's National Resources Committee. The author is in the department of social science, Columbia University

sales possibilities by making its use simpler and its power greater were accepted slowly. The self-starter was invented in 1899, and installed on one brand of car in 1902. It was impossible, however, to get manufacturers to spend money on "refinements," and by 1912 less than 5 per cent of the manufacturers were offering cars with self-starters as standard equipment.

The textile industry was the first battleground of machine technology against hand tools. The beginnings of the conflict developed as early as the thirteenth and fourteenth centuries on the Continent, and for three centuries guild and local authorities frequently ordered new machines destroyed and their inventors imprisoned. In 1397, for example, the tailors of Cologne were forbidden to use a machine for pressing the head of pins. In 1272 Borghesano's automatic machine, run by a water wheel, for twisting silk thread, was used in Bologna. Its secret appears to have been maintained through fear of the death penalty, so that it did not become known in Switzerland until 1555 and in England until 1718. It is reported that about 1579 the Council of Danzig had ordered strangled the inventor of a machine which would weave four to six pieces at once, lest his invention reduce many workers to beggary. Rev. William Lee, who, in 1589, invented the first knitting machine, the so-called "stocking frame," was refused a patent of monopoly by Queen Elizabeth and James I. He then accepted an invitation from King Henry IV of France, and went to Rouen in Normandy with several looms, only to have his inventions unrealized because of the king's assassination.

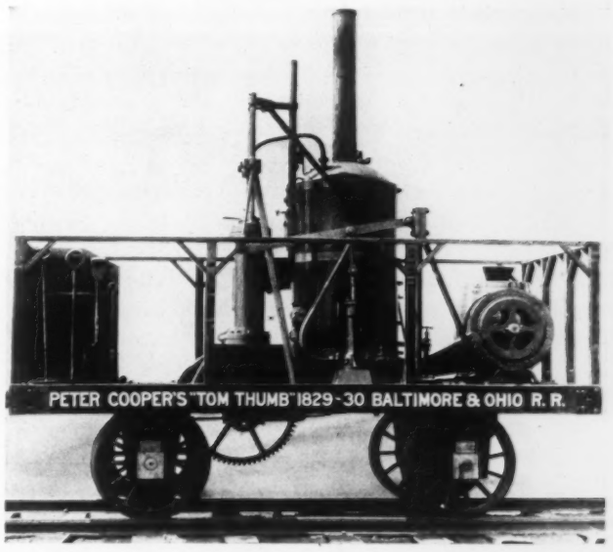
Opposition to power-driven machinery flared when steam, used in 1785 for the first time in a cotton mill, began to be installed widely. In 1793 "respectable residents" at Bradford, England, protested successfully against the use of the steam engine in worsted mills as "a smoky nuisance" by threatening the proprietor with legal proceedings. Strenuous resistance to the use of steam looms for cotton weaving arose at Lancashire.

Workers Hostile to Textile Machines

As new machinery, which allowed for increased production was invented in the textile industry, it met the opposition of the executives of the industry, who feared that overproduction would disturb existing price levels, and who hesitated to scrap the older machinery until it was worn out physically. They likewise invariably aroused workers' hostility because of the dread of technological unemployment, the initial difficulties of adapting themselves to the new machinery, and the lowered wages and greater speed-up that usually accompanied their introduction.

There has also been strong consistent opposition to changes in technology in agriculture. When Jethro Tull sought to introduce mechanical planting of grain by drilling machines to displace broadcast sowing by hand, he was by threats of violence forced to leave many English farm villages. Amos Bronson Alcott would not allow his land to be manured because he considered it "a base and corrupting mode of forcing nature." Whitney's cotton gin was not accepted at once, not only because of the rumor which had its source in Manchester, that the gin injured the cotton fiber, but because of the excessive levy which Whitney and his partner Miller, imposed on the planters who used it.

Small-town bankers and businessmen refused for many years to lend money on tractors on the grounds



Tavern keepers and stagecoach owners objected to railroads because of encroachment on their business

that they were a menace to farmers. They argued not only that farmers could not operate the machine profitably, but also that if they were successful, the farmer would have too much leisure time. They had investments in horses and foresaw their eventual decline in price if tractors were utilized. The national horse associations led in circulating propaganda against tractors and were joined by the local bankers. Farmers were easily susceptible to such a campaign for the price of tractors was high, horse-drawn implements became almost a total loss, and the farmers were often sentimentally attached to their horses. Farmers rarely had sufficient evidence one way or the other on the question whether the breakage on the tractor and the amount of fuel required were excessive. The opposition of the farm wage workers, displaced by the tractor, was also great.

It is apparent from these examples that the psychological factors of habit, fear, desire for personality equilibrium and status, and the tendency of groups to coerce their members to conformity, are latent predisposing factors toward resistance to change. The manner and degree in which these factors function

depend on forces in the cultural environment. The most potent of the cultural factors are clearly economic. Efforts to maintain economic advantage and hegemony over competing classes, and over competitors in the same industry; costs of introducing the new method or product, which in its early form is usually crude and unstandardized, and but one of a number of innovations designed to solve the specific problem at hand; the losses incurred through the depreciation of machinery and goods made obsolete by the innovation; the unwieldy structure and the rigidity of large scale corporate enterprises that hesitate to disturb a market which already yields profits through restricted production; the difficulties of small-scale enterprise to make the necessary capital investments; the stultifying influence of capitalist crises; and labor's efforts within a profit system to prevent being victimized by technological unemployment, by the loss of skill, by speed-up and by lowered wages.

Under capitalism, the almost exclusive incentive to the incorporation of technological improvements into industry has been the drive for profits. The profit motive undoubtedly served as a ferment, accelerating change, in the early days of capitalism in contrast to a relatively static feudal economy. Its effectiveness in this respect was and is dependent upon the availability of markets, and the need to acquire or maintain control of that market in competition. When new continents were being opened as markets, and capitalism was an expanding economy, new machinery could more readily be used to supplement the old. Competition between entrepreneurs, although it led to wasteful anarchic production and marketing, to some extent stimulated a response to technological innovation to keep ahead of competitors. But in the degree to which monopoly in the setting of the profit system is able to control prices, standardize products, and restrict production, alertness to technological change is diminished, a brake is put on inventions and their applications.

In summary, resistance to technological change has been so much a part of the texture of the historical process, that it cannot be ignored when the future of technology is charted. There are psychological factors in individual and group behavior which predispose toward inertia in receptivity to innovation, but these may be counterbalanced by potent incentives that promise material and nonmaterial rewards. The basic determinants of the presence or absence of impediments to technological change lie therefore in the nature of the social, and primarily the economic structure of a society, in the degree to which it offers incentives to the masses of the population and in the manner in which these can be realized.

Certified Steel Plan Announced

HAVING in mind a series of articles published recently in MACHINE DESIGN, under the title, "Heat Treatment as It Affects the Designer," it will be of interest to many readers to know that Joseph T. Ryerson & Son, Inc. has just announced a unique system to aid steel users to secure more uniformly satisfactory results. This "Certified Steel Plan" is designed to solve many of the problems that have developed during the rapidly increasing use of alloys. Under the system, the company selects entire heats of alloy steels that come within certain narrow analysis limits. The steel is tested for chemical and heat treatment characteristics and complete data is prepared for delivery to every customer buying the steel, whether only a few bars or several tons.

Most of the alloy steel used today is subjected to heat treatment before use, for the purpose of developing strength, hardness, resistance to shock, or other special physical characteristics. The response of alloy steel to heat treatment depends partly on analysis and partly on the general hardening characteristics of the particular heat in question, these characteristics being governed by the structure of the material, inherent grain size, etc. The accuracy with which a melter can work is limited, therefore, no producing mill can accept specifications for exact analysis but must be allowed a quantitative range of each element.

When large tonnages are involved, the user can purchase whole heats and it is then practical for him to analyze each heat and also test it for heat treatment response. In this way he is able to control his heat treatment process so as to offset any differences between heats. When average lots of alloy steel are purchased from stock, the customer can hardly afford to run expensive analysis and heat treatment tests on the different bars as they are received. Therefore, the only solution of his problem is to furnish him with alloy steel that has already been analyzed and tested before he gets it.

Heat treatment of a steel nowadays is usually done in compliance with instructions from a designing or engineering department, and certain degrees of hardness or strength are called for. In order to secure these definite results, the heat treater, if he is working with a more or less unknown steel, may have to repeat his heat treating operation, or he may consider it more desirable to run preliminary tests. Certified steel makes preliminary tests unnecessary because tests have already been made on the heat and the results have been placed in the hands of the heat treating department.

Scanning THE FIELD FOR Ideas

PNEUMATIC tires are usually associated with highway vehicles but there is an increasing amount of evidence that their advantages are becoming recognized in various other fields. A case in point is the Mono Tractor pictured in *Fig.* 1.

This electrically-driven overhead carrier unit has been designed by the American Monorail Co. for application to smooth rail systems. Traction is given by a balloon tire which is inflated against the under side of the rail on which the unit rides. The rubber tired drive wheel, which on some of the models is of the type known as the airwheel, is driven through a reduction system. Control either is by pendant pushbutton station, as illustrated, or it can be remote or automatic.

The tire, when inflated against the rail, gives a surprising amount of traction regardless of the load, its pressure giving a preloaded effect as far as the grip on the rail surface is concerned. Starting and stopping are accomplished rapidly but with unusual smoothness and absolute quietness. The advantages of this pneumatic tire traction are especially noticeable through switches, around curves and especially on steep grades where slippage would be most likely to occur.

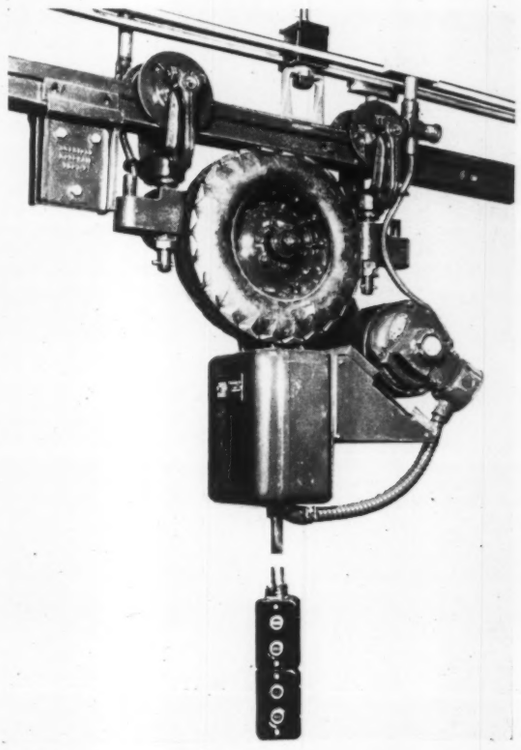


Fig. 1—Balloon tire inflated against bottom of rail gives powerful traction to overhead carrier

In practice one of these units carries a 5-ton load on a heavy hoist around an I-beam of 4-foot radius as easily as along a straight track. Another carries a combined load of 4-tons up and down a 5.25 per cent grade under perfect control. The system also has been applied to double-rail bridge cranes, a single motor driving an airwheel on each rail through a cross shaft. A 62-foot crane has been driven successfully by a 1½-horsepower motor in this way.

Curtain of Light Gives Safety

WITH increasing use of punching and fabricating pressing in industry — especially those machines of very large size — the safety problem has become an exceedingly important one. The illustration presented herewith as *Fig.* 2 shows a large embossing press on which protection is afforded by means of a "curtain of light". This system, developed by the Electronic Control Corp., is particularly adaptable to modern presses having electrical or hydraulic control, and insures safety without in any way hindering the operator.

The equipment consists of: A specially designed light source; a system of mirrors; a phototube housing; and a phototube magnifier. The light source is a steel cabinet fitted with four standard automobile headlight bulbs with self-contained transformer. The cabinet is fitted with four lenses ground to project the high, narrow wall or curtain of light, which can be seen clearly as it falls on the left shoulder of the operator. The light source can be seen through the opening of the press. At the side of the press opposite the light source are mounted two mirrors, each adjusted to reflect the beam 90

degrees, thereby throwing it around three sides of the press and into the phototube cell housing.

The phototube lenses are so arranged that every section of the curtain of light impinges upon the cathode of one of its four phototubes. Thus there are no dead spots where interception might occur without actually cutting off the light from the cathodes. Vanes on the admittance side of the housing eliminate periodic sensitivity adjustment to the amplifier, which otherwise would be necessary to compensate for the ever-changing values of extraneous light. The power pack for direct current is built in, and the 90-volt tubes are operated at slightly less than 55 volts to increase their useful life above the 35,000 hours which they ordinarily would have.

As soon as the operator has placed the work and turns about to get new stock, the curtain of light is cleared completely and the press goes through its closing cycle. In the event of power failure, tube failure, air pressure failure, or a burned out lamp, relays in the amplifier instantly go to de-energized position. In this position the circuit to a solenoid-operated air valve opens, thus turning off the air and exhausts the air cylinder. Instantly a weighted arm disengages the clutch and applies the brake, and the press stops within a $\frac{3}{8}$-inch movement.

Steel Bellows Seals Joint

EXPANSION joints required in pipe lines subject to thermal expansion and to movements due to other causes, must withstand pressure, temperature changes and vibration without possibility of leakage or deterioration, preferably without demanding service attention.

An interesting design to meet these difficult conditions has been worked out by the Foster-Wheeler Corp. This is shown diagrammetically in *Fig.* 3. As is indicated by the diagram, welding plays an important part in the fabrication of this joint — not only in the sliding members but also in the bellows member, upon which complete sealing without packing depends.

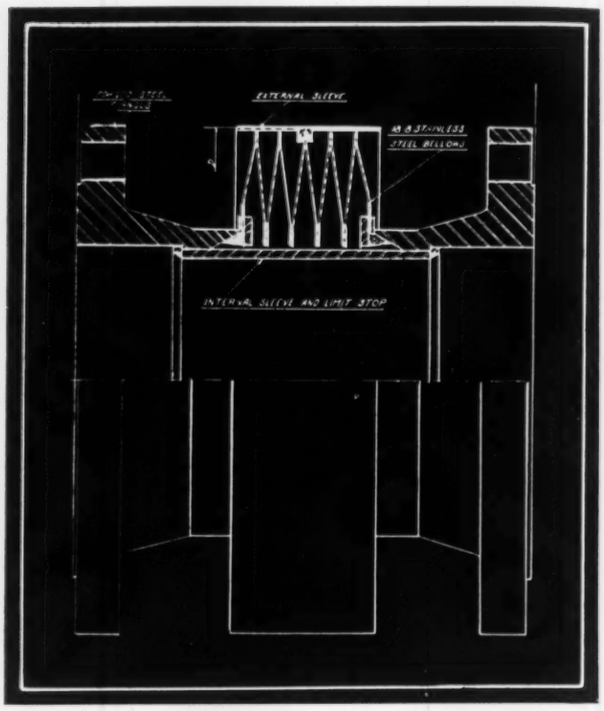


Fig. 3—Welded bellows of stainless steel forms permanently tight seal for expansion pipe joint

The flanges are steel forgings and the bellows is made up of thin plates of low carbon 18-8 stainless steel. These are joined at their edges by a special fusion welding process and under test have withstood pressures of 2500 pounds per square inch without failure. The bellows assembly is welded and sealed to the flanges by means of heavy reinforcing rings.

The internal sleeve, which is a free sliding fit within the flanges, guides and limits their movement — the flanges being counterbored to provide shoulders to engage the limit stops at full extension. It will be noted that the limit stop rings are welded to the ends of the internal sleeve. The pur-

Fig. 2—By means of a projector and mirrors, a safety curtain of light is thrown around this press, which can function only when the operator is entirely out of the danger zone

pose of the sleeve on the outside of the bellows is to provide a support for insulation and to prevent foreign particles from falling into the folds of the bellows.

Valve Lifter Adjusts Itself

SELF-ADJUSTMENT of a valve lifter to zero clearance has been accomplished by a hydraulic method developed at the Wilcox-Rich division of the Eaton Mfg. Co. This new valve system is depicted by *Fig.* 4.

The outer wall or shell of the hydraulic lifter is similar to the ordinary type, except for the elimination of the threads commonly used for adjusting. In place of these threads there is a straight machined hole with a shoulder at the bottom to receive the hydraulic unit.

This unit comprises a cylinder, a plunger, and a ball check valve. Self-adjustment is accomplished by supplying oil under pressure from any suitable point in the engine, to a reservoir located back of the lifter bracket — connection being through drilled holes. There are two holes in the bracket — one a "bleed" which allows any accumulation of air in the reservoir to escape through the lifter guide hole into the upper crankcase; the other, at a lower level, a feed bringing air-free oil to an annular groove in the lifter body and thence into the lifter.

In a complete cycle of the cam, starting with lifter on base circle, the hydraulic plunger is actuated outwardly by a spring to take up any space between end of valve stem and cam. As the cam revolves, initial pressure seats the ball check, trapping oil under the plunger, so that the valve is lifted by a column of oil. While the valve is off its seat slight leakage of oil occurs which is necessary to compensate for any expansion in the valve gear. At point of closing the supply below the plunger is replenished, thereby eliminating any clearance.

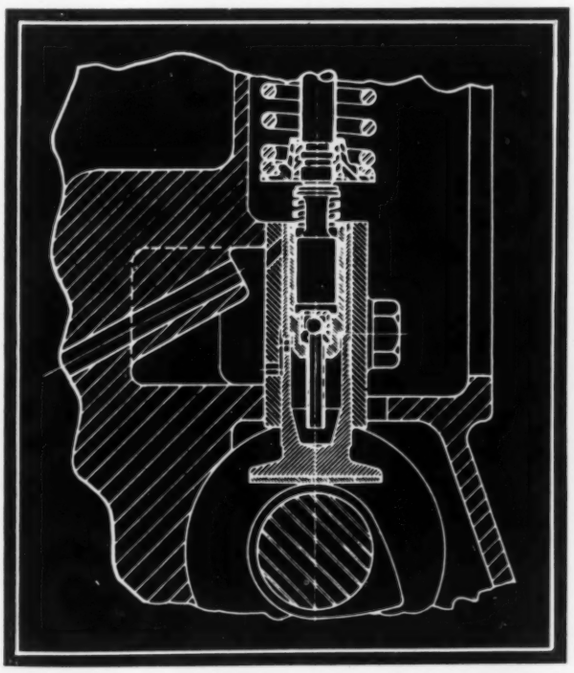


Fig. 4—This hydraulic lifter corrects its length to zero clearance each time the valve closes

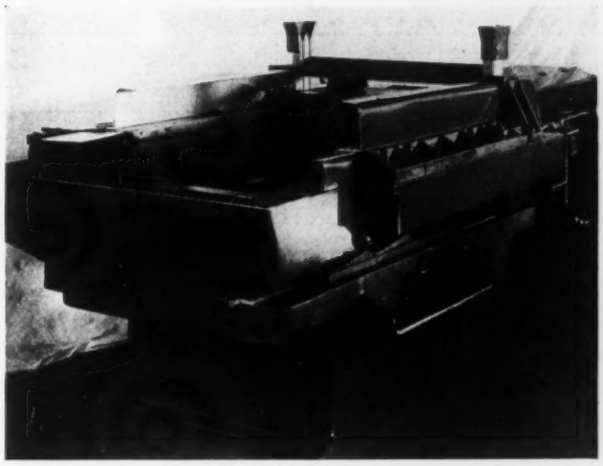


Fig. 5—Automatic machine broaches ends of rods used to align adjustable seats of automobiles

Two Ends Finished at One Pass

ADJUSTABLE front seats for passenger automobiles have introduced a machining problem in connection with the cross rods on which are mounted the gears which roll on concealed racks to maintain alignment. These rods must have at both ends provision for mounting the gears. This often is taken care of by flatting the ends top and bottom.

To provide fast and accurate means for broaching the flats on these long rods, the Colonial Broach Co. has worked out an interesting adaptation of a horizontal pusher-type machine, as shown by *Fig.* 5. Rods can be seen in the magazine hopper ready to drop down into the work-carrying fixture.

The cycle of this machine is automatic and its operation continuous. The blank rods are loaded into the hopper by the operator, and from there they drop down—two at a time—into the fixture which pushes them through the broaches. These broaches are designed so as first to shear the ends of the rods to length. About 3/32 inch has been allowed for this and the machine automatically equalizes the amount of projection so that the same amount is removed from each end. Following this, V-slots are cut across the ends to permit spreading at assembly to lock on the gears. Next the two flats at each end are broached.

All of these operations are performed at one stroke, at the end of which two finished rods are kicked out automatically, where-upon the ram returns to pick up two more blanks. This machine is hydraulic.

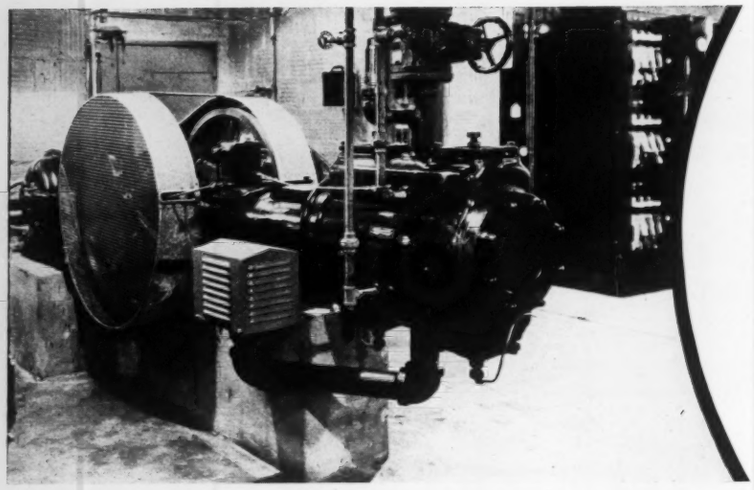


Fig. 1—Dry type, textile air filter efficiently cleans air entering this large diesel engine

Machine Life with Air

By Fred Kelly

AIR is usually considered comparatively clean, yet if one will take careful notice of his shirt collar after a day in the city he can readily surmise the amount of dirt suspended in the atmosphere. Fortunately human beings (with the exception of hay fever sufferers) are not adversely affected by dirty, dust-laden air, but machines are.

When one realizes the amount of air consumed by an internal combustion engine in a few hours operation and is aware that a particle of dirt is contained in every few cubic feet of air, he is amazed that engines do not wear out in a week or two. With the burning of one gallon of gasoline there is taken into an engine the equivalent of all the air in a room, 10 x 12 x 10 feet, or approximately 1200 cubic feet of air. Assuming a vehicle averages 12 miles to a gallon of gasoline, then in a 300 mile trip about 30,000 cubic feet of air would pass through the engine.

A glance at the figures for a 1000 horsepower diesel engine which averages 3.2 cubic feet of air per minute per rated horsepower shows even more clearly the huge amount of air consumed over a long period of operation. Assuming the engine is run 8000 hours a year, it will take in 1,536,000,000 cubic feet of air in that time, or at the rate of 1,920,000 cubic feet every 10 hours of operation.

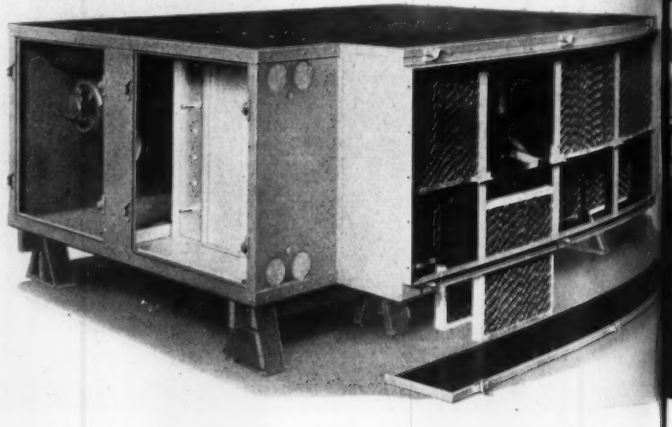
Pollution of air from dust and dirt runs from 3.8 tons per cubic mile in average atmospheres to as much as 11 tons in industrial sections. Knowing the large amount of air sucked into an engine and realizing the density of dirt and dust in the atmosphere, it is easy to understand why engine wear is materially increased by unclean and unfiltered air.

Of course in the interests of common sense it is hardly fair to state that all the dirt which is sucked into an engine is immediately deposited on a vulnerable spot where it starts a deadly process of wearing out the part. Probably nine-tenths of all dirt which enters an engine is blown out the exhaust without hesitating in the combustion chamber to cause wear. Nevertheless, enough dirt does remain to be a serious problem to the engineer who is endeavoring to combat wear in his product.

Other evils than wear naturally result from the introduction of dirty air into compressors, engines, air-conditioning units and similar equipment. Dirty air clogs up valves, pipes and ducts, compressed air must be clean for the majority of its applications, and for air-conditioning systems one object of the equipment would be wasted if the treated air were not clean. Paint spray booths often employ air filters to separate paint particles from the air which circulates around the booth.

It is only natural that engineers have devised vari-

Fig. 3—Panel type filters are easily removed for cleaning and inspection in air-conditioning unit



Is Increased Filters

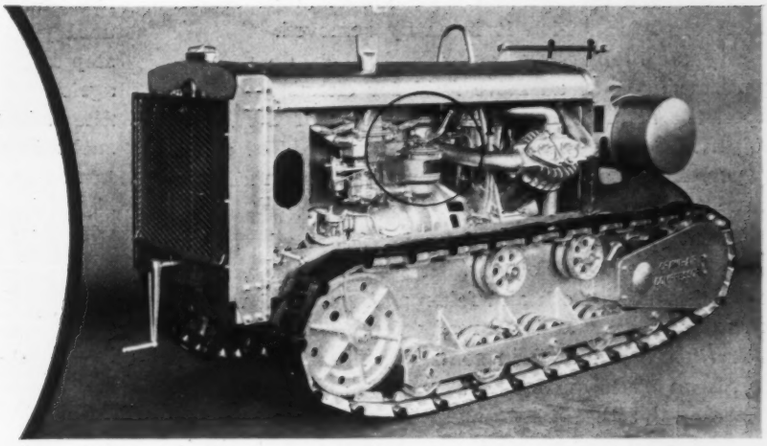
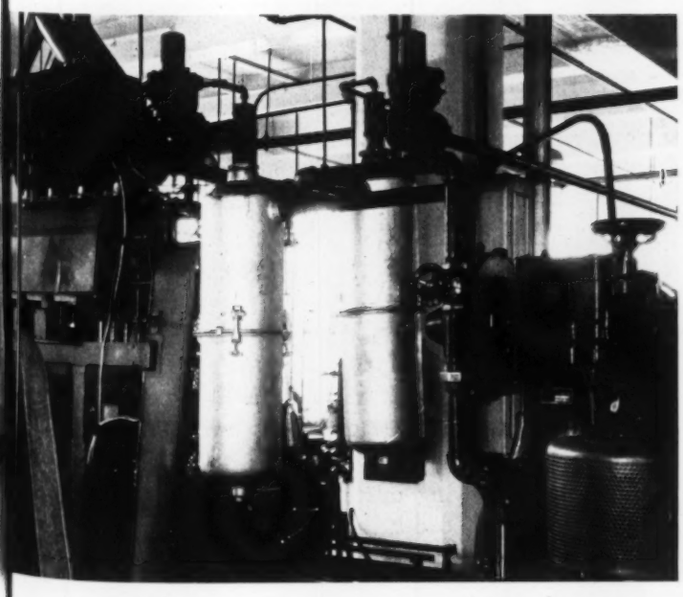


Fig. 2—Motorized compressor employs air filter on both engine and pump intake manifolds

ous methods of filtering air to overcome the harmful effects of dirt. Early types of air filters were made of fine screen or steel wool. In fact much the same materials are used today, but great progress has been made on adapting the correct type of filter for specific applications and so designing it that air restriction is reduced to a minimum.

Filters for machine use may be generally classified as the nonviscous or straining type and the viscous or baffle-impingement type. Each class has its advantages and certain applications for which it is superior. Hundreds of different type filters are on the market but practically all fit into one of these classifications. Another classification for filters might be the throw-away or replacement type and those that are self-cleaning or may be cleaned and used again.

Fig. 4—Food particles which might lodge in pump used with canning equipment are trapped in air filters



Certain essentials are required in any good air filter. First and most important it must be efficient in the removal of harmful and objectionable impurities in the air. It must also be able to operate efficiently over a considerable range of air velocities. Low frictional resistance to air flow is an important consideration; the pressure drop across the filter should be as low as possible. A good filter must have a large dust-holding capacity without excessive increase of air resistance and be easy to clean or clean itself automatically. And last, the viscous type filter should be so constructed that air leaving it will not contain particles of oil or the charging liquid. Because of this possibility straining type filters are usually employed with air-conditioning equipment used in offices or stores to eliminate any possibility of the filtered air containing the charging liquid.

The principle of air cleaning used in baffle-impingement type filters is that of adhesive impingement. Dust and dirt in the air, especially soot and carbons, are trapped and retained by successive impingements on viscous surfaces. Hundreds of different materials and construction are used in manufacturing this type of filter, but all employ some form of wire, screen, cuttings, steel wool or similar substance which has an adhesive coating, usually oil, to catch dirt particles in the air.

Filters of the impingement type may be divided into those which are manually oiled or covered with a dust collecting liquid and those automatically washed in oil. In the former the filtering unit is removed and washed and reoiled while in the au-

tomatic type dirt collects in the bottom of an oil reservoir from which it is easily removed.

Dry air filters, as the phrase implies, do not depend upon oil or adhesive fluid for cleaning air but upon the straining or screening action of the filtering medium. Dry filters are usually made of cloth, paper, felt or similar materials and are made in a wide variety of types.

Usual practice is to replace dry filters when they have become well clotted with dirt. However, some types including cloth and felt may be cleaned with a vacuum cleaner and be ready for further service. Glass fibers are used in some dry filters. This type forms an effective dust barrier that is quite efficient. Cleaning the filter is easy and it has the important advantage of being able to withstand relatively high temperatures.

The life of any machine such as a compressor, engine, air conditioning equipment, blowers, etc. will be increased considerably by the use of an air filter. Every automobile manufactured in this country is now equipped with an air filter of some description.

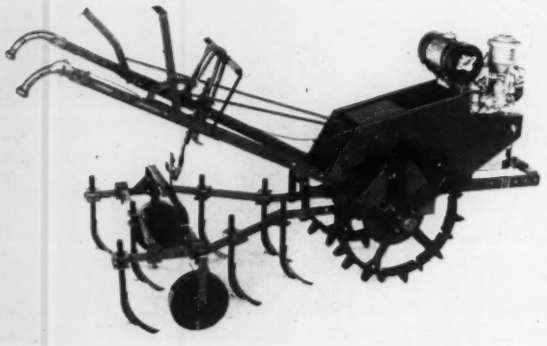
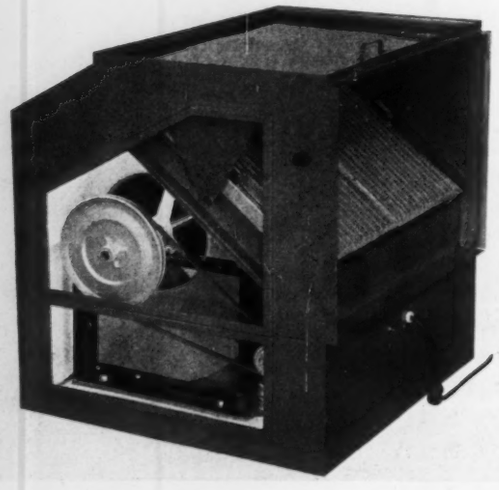


Fig. 5—Small engine on farm cultivator is protected with oil bath filter

Fig. 6—Filters with oiled surface catch dirt particles before they enter blower



Many of these have little filtering capacity and are used principally as a noise silencer, but at least a step is being made in the right direction. Motorized agricultural machinery is being equipped with air filters. Working in dusty atmosphere where an engine sucks in much abrasive dust, the use of filters on farm engines reduces wear of cylinders and pistons. *Fig.* 5 is an example of a small motorized cultivator with an oil bath type filter.

Filters of this latter type have become popular since they were introduced a few years ago and they are being used on thousands of engines and compressors. As seen in *Fig.* 8 the filter consists of the conventional filter element made up of several layers of crimped galvanized screen and an oil reservoir in the bottom with suitable baffles to direct the oil over the element. Ordinary engine oil is added from time to time to keep the level even with the bottom of the baffle plate. Pulsations in the intake manifold of an engine or pump cause the oil to be sprayed over the element through which the incoming air passes. Dirt sediment collects in the bottom of the oil reservoir from which it must be cleaned. Filters of this type range in size from three inches to four or five feet in diameter.

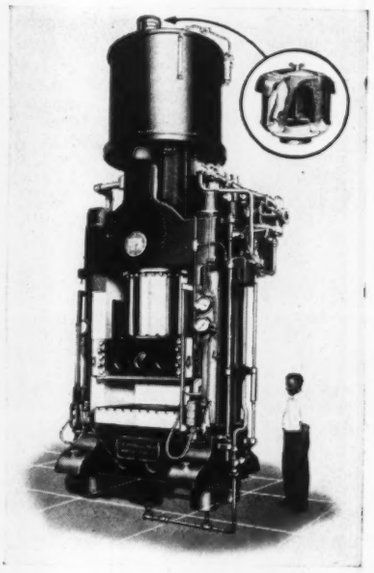


Fig. 7—Air which displaces oil in giant hydraulic press is first cleaned by passing through filter, shown in inset

This type of filter is ideal for such applications as that of *Fig.* 2 in which an oil-bath model is used on both the intake manifold of the engine as well as on the intake of the compressor. This type of filter may be equipped with a spring-loaded valve which obviates the chance of damage from motor backfire. If such occurs the valve raises and allows the excessive pressure to escape without blowing back through the oil and filter element.

In porcelain spraying operations large panel-type filters are used to collect the grit which otherwise would float about the room. Panel filters are also

used to trap oil vapor sprayed on automobile parts which are to be shipped to prevent corrosion. The captured oil is returned to the supply tank and used over again. Tanks holding inflammable liquids are made safe by placing air filters over the vent of the tank. Most types of air filters are satisfactory flame arrestors and on engines they usually serve a triple purpose: Clean the air, prevent dangerous backfires through the intake manifold and act as an intake silencer. The filter shown on the airplane in *Fig.* 9 answers these three purposes; its most important function, however, is to act as a flame arrestor if a backfire should occur.

An interesting air filter application is shown in *Fig.* 7. This is a large hydraulic press and in operation, when the ram or piston goes down, air enters the cylinder to displace the oil which is used. To prevent dirty air entering which would contaminate the oil and in time probably cause wear or clogging of valves, an oil-bath type of filter is employed.

Many Filter Uses on Railroads

Railroad equipment must be protected from the action of dirt, cinders and abrasive particles. Air brake compressors on locomotives utilize air filters to prevent dirt entering the braking system. Generators on railroad passenger cars are mounted under the car and unless some method is used to prevent dirt and dust from the roadbed entering them wear would be tremendous. Panel filters are installed in front of the blower wheel which cools the generator and bearing wear or armature failure is no more a problem for these units than generators operating under clean conditions. Practically all passenger car air-conditioning units must use filters of some type. In fact the greatest service of this equipment is cleaning the air rather than cooling it. Their efficiency is attested by the fact that a person can now remain in a Pullman car overnight without looking and feeling as though he slept in a coal mine. *Fig.* 3 is an example of a panel type air conditioning unit. The illustration readily shows how the filter elements are placed and may be withdrawn for cleaning. A smaller type of home or office air conditioner is shown in *Fig.* 6. An unusual air filter application is depicted in *Fig.* 4. The two large filters seen in the illustration are installed between the sealing chamber and a vacuum pump on a vacuum packing machine. They are especially designed to prevent the passage of food particles from the place at which they are packed to the pumping equipment. By their use, the filters eliminate sticking valves and excessive wear formerly caused by the intake of food particles.

An example of the dry, straining-type of filter is shown in *Fig.* 1. Applied to a large bore diesel engine, this filter with textile element has a high cleaning efficiency and may be easily taken apart for inspection and removal of dirt and dust. In the past few years,

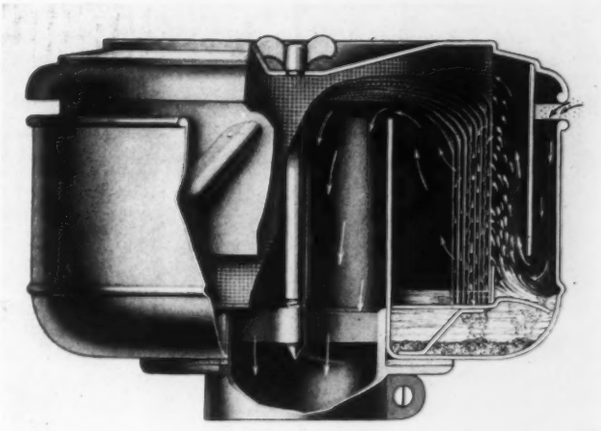
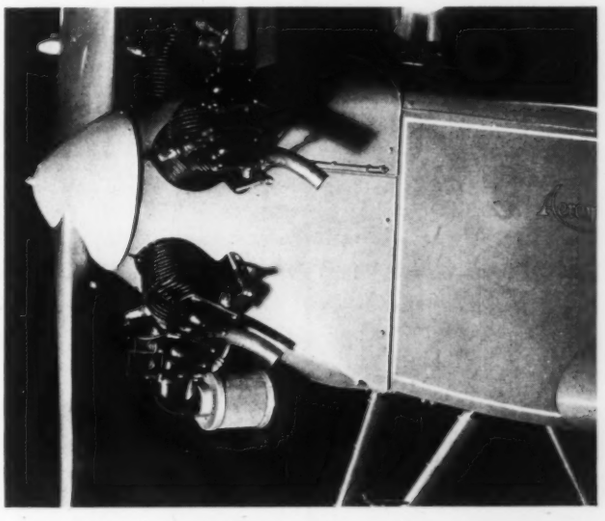


Fig. 8—Pulsations of engine or pump spray oil over screen in automatic filter

Fig. 9—Filter on airplane acts as flame arrestor as well as air cleaner for engine



the use of air filters on diesels has increased considerably. Operating as they do, in most cases, in dusty surroundings and being the type of equipment on which repairs are costly any method of reducing wear has been eagerly accepted.

Though the greatest use of air filters on machines is still in the engine and compressor fields, new applications are being found constantly. With the current popularity of air-conditioning equipment for trains, airplanes, buses, homes and offices, air filters find a lucrative outlet. Air is dirty in most places where machines operate and the designer knows that next to mistreatment, abrasive dirt can destroy a machine quicker than any other single factor—a point well worth consideration in the design of any machine where an air filter can conceivably be employed.

Acknowledgement is given to the following for assistance in the preparation of this article: Air-Maze Corp., Coppus Engineering Corp., Staynew Filter Corp. and American Blower Corp.

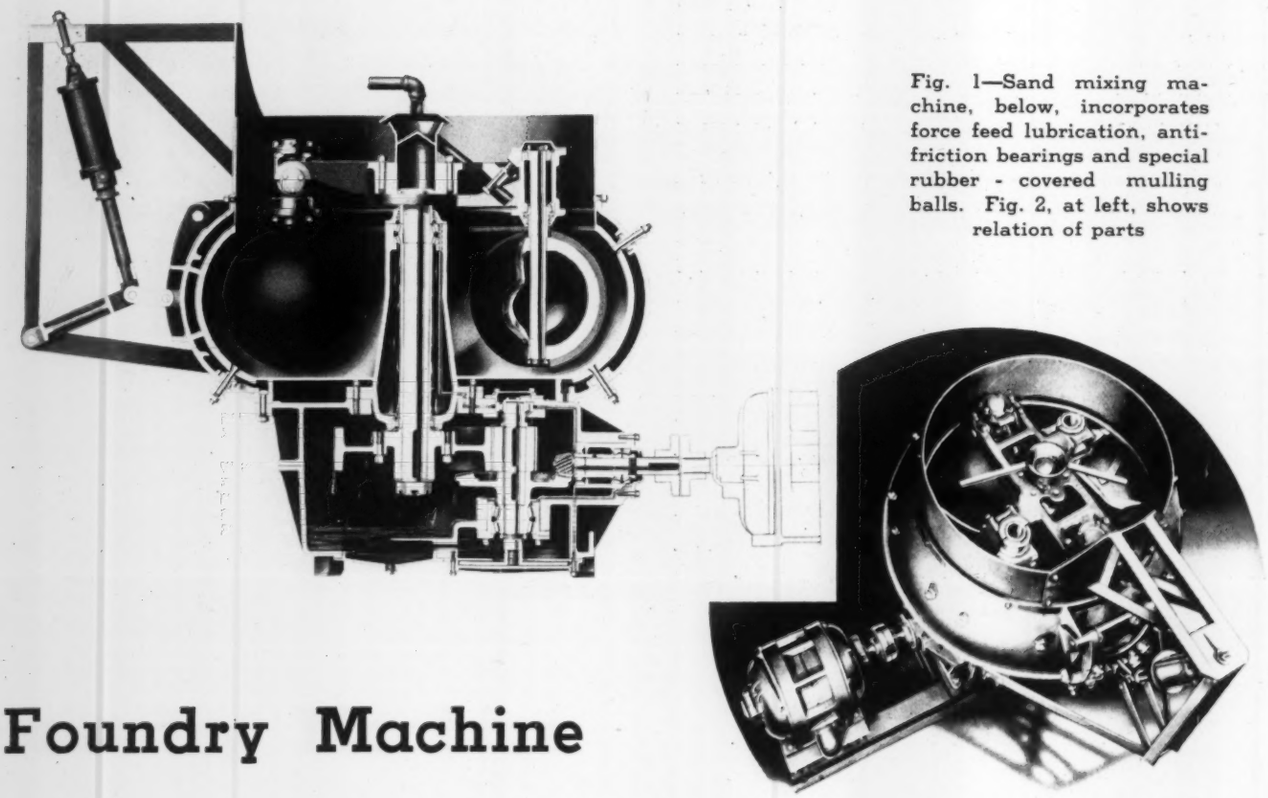


Fig. 1—Sand mixing machine, below, incorporates force feed lubrication, antifriction bearings and special rubber - covered mulling balls. Fig. 2, at left, shows relation of parts

Foundry Machine Departs from Tradition

FOUNDRY equipment ordinarily is not placed in the category of precision machinery on a par, for instance, with the modern and efficient machine tool. A radically forward step in the design of such equipment has been made, however, with the introduction of the Beardsley & Piper Speedmullor, *Fig.* 1. Designed for mixing and conditioning foundry sand the machine possesses many features which make it stand out from the ordinary mixing machine. Antifriction bearings are employed, force feed lubrication is used and an operation such as opening the mulling bowl is performed pneumatically.

One of the most interesting features of the Speedmullor is the application of rubber to the mulling balls to resist abrasion. As can be seen in *Fig.* 2 the two large cast-iron balls which turn against the sides of the bowl are rubber covered. They are 20 inches in diameter, pivotally supported to swing out by centrifugal force, and are adjustable as to throw. The crosshead revolves at 90 RPM and is equipped with two outside and two inside plows for delivering sand outwardly and upwardly. The mulling action, of course, takes place between the balls and the bowl when the sand is in suspension. This rubber covering, ¼-inch thick, far outlasts steel or alloy balls and performs the mulling rather than grinding action which is striven for in the machine.

The unit is designed to use antifriction bearings on the motor shaft, all internal drive shafts, and on the muller balls as well. Each shaft is fitted with a double tapered roller bearing on one end and a floating bearing on the other to allow for variations in shaft length caused by heat or cold.

A novel lubricating system for this type of machine has been worked out. A turbine oil pump is mounted on the lower end of the vertical bevel gear shaft at the bottom of the gear housing. The oil in the sump is forced by the pump through openings in the gear case wall to the top of the turret in the center of the driving mechanism where it drips down on gears and bearings. It then passes through a copper screen back into the oil pump sump.

All operations of the machine are controlled by pushbuttons from a single position. These include loading, unloading and adding water to the sand mixture. For discharging the mulled sand, a pneumatically controlled door arrangement is provided which opens in the side of the bowl.

Location of Noise Source Is Scientific Study

By C. W. La Pierre

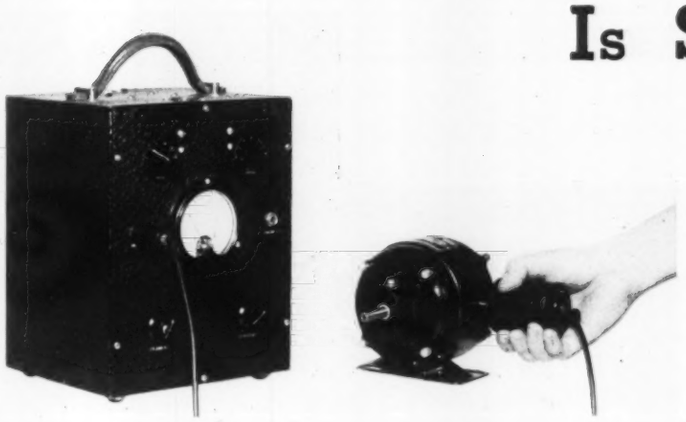
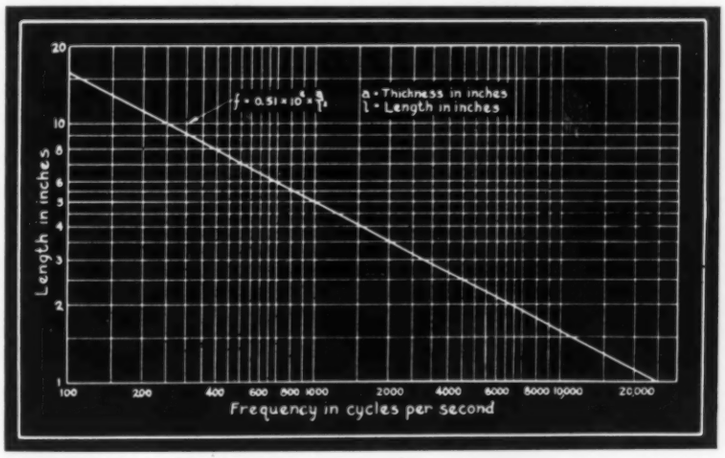


Fig. 1—Minor vibrations in this motor are easily detected by the vibration velocity meter

Fig. 2—Graph shows natural frequency of vibration of steel bar either free or clamped at both ends, as it varies with length



MUCH has been said during the past few years on noise elimination. To many the results are meager; to others, substantial. Whatever the present state of affairs, however, design engineers have available today a good foundation upon which quiet machines can be designed.

This foundation is comprised of four things: First, some idea of what sound level means in quantitative terms; second, a better understanding of how a machine part or air stream can vibrate to produce a noise; third, some measuring instruments to tell what is going on; and fourth, definite results in at least a few cases to show that something can be done.

It would appear that such a background or foundation is necessary for designing quiet machines and since it cannot be gained overnight, noise elimination will be an evolutionary rather than a revolutionary process. The initial steps may seem small to the designer and user alike, but each step points the way and progress can be made relatively rapid by this procedure.

The first of the four basic factors in quiet machine design as given in the foregoing is a quantitative understanding of sound levels. The sound level of a residence will likely run somewhere between 30 and 55 decibels. In an office, it will probably be from 40 to 75, and in the factory it will probably run from 60 to 90. Three sets of figures like these do not appear important, but actually they represent a great deal of progress. Design engineers interested in commercial products cannot possibly work out page after page of mathematical computations every time they want to find out how much noise a particular machine produces and even then have nothing intelligible to pass along to a customer. Consequently it is a real achievement to be

EXPERIMENTS in "tracking down" machine noises have laid a basis from which truly quiet machines may be designed in the future. In this article by Mr. La Pierre, of the general engineering laboratory, General Electric Co., instruments used to detect and classify noises are explained and an analysis made of factors producing noises in machines of various different types

able to say this machine has a sound level of about 40 decibels and with that one number tell how loud the device will sound in a particular application.

This ability to express sound level in numerical terms is the result of the work of the American Standards association (A.S.A.) whose publication Z24.1 defines what is meant by decibel as well as other acoustical terms such as loudness, intensity and pressure.

These standards represent the accumulated knowledge and technique of a large amount of experimental and mathematical investigation. Considerable benefit

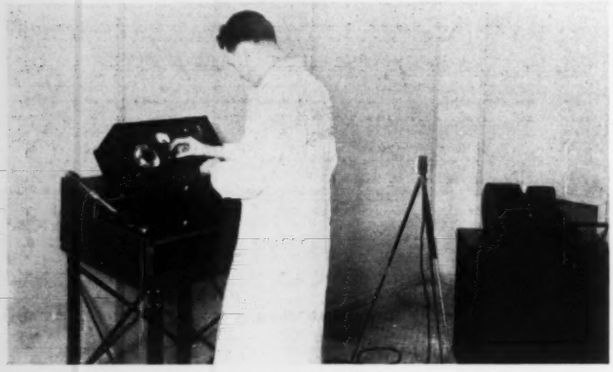


Fig. 3—Determination of the magnitude of frequency components in sound from an air-conditioning unit is possible with the sound analyzer

to the design engineer comes in not having to survey each of these previous investigations. Insofar as overall noise is concerned, the designer can and should think in terms of decibels of sound level. It is not so necessary for engineering use to remember too much about the derivation of the unit provided there is a good understanding of what the decibel means in terms of actual sound level encountered. Table I will aid in forming this picture.

TABLE I

Sound Level of Representative Machine Locations

	Decibels
Threshold of audibility*	0
Quiet garden	20
Country residence	30
Average residence	40
Quiet office	50
Average office	60
Average restaurant	60
Department store	65
Noisy office	65
Noisy restaurant	70
Stenographic room	70
Noisy street, large city	85
Boiler factory	100
Thunder	110
Threshold of feeling*	120

* The threshold of audibility is the minimum value of sound pressure which gives the ear a sensation of sound. The threshold of feeling is the minimum value of sound pressure which will stimulate the ear to a point at which there is the sensation of feeling.

The second basic factor in quiet machine design is a better understanding of how machine parts and air streams vibrate to produce noise. Experience to date in noise elimination has taught much about the sound-producing possibilities of a machine. The first time the designer faces a noisy machine he is apt to see the machine and hear a noise, but the two are no more connected than that. With a little more experience, he hears the noise, sees the machine and automatically searches for those parts which might produce a noise of the pitch he heard.

Hard to Locate Noise Visually

How to acquire most efficiently the ability to locate the most likely source of noise-producing vibrations visually is a question. Here again there is a large amount of mathematical literature on vibrating systems. Such analyses are never complete, however, except for the most simple systems. A complete mathematical analysis of the usual machine confronting a designer is rarely feasible. On the other hand, the fundamental mathematical relations between mass, elasticity and natural period are important and it is very helpful in any analysis to have computed oscillation frequencies of simple bars of dimensions approximating roughly those to be found in the machine under study.

Fig. 2 shows how the natural period of a bar of steel varies with length. Such curves are very simple but they represent by far the greater part of the mathematical study necessary for a noise reduction problem.

This statement is made with some hesitation because many excellent results have been achieved by detailed and ingenious mathematical analysis. Even so it is first necessary to have a broad quantitative picture of a few simple vibrating systems in order to plan a reasonably accurate attack on a particular problem. The detailed accurate analysis can then be made by actual experiment and measurement with greater certainty than can be expected of mathematical analysis.

Vibrating Systems Must Be Understood

The second basic factor in quiet machine design is, therefore, a good understanding of simple vibrating systems which serves as a guide to the sources of the trouble.

The first two basic factors in quiet machine design are of a general nature. Their importance, however, should not be underemphasized just because they appear simple and do not bear immediately and obviously upon the problem at hand.

Of course, to actually reduce noise in a machine, it is necessary to know just what is causing unwanted sounds. Here again, however, the experience of the past few years has provided a set of instruments to measure the noise producing vibrations of a machine

or an experimental set-up to represent the machine.

These measurements go beyond the sound-level measurements in several important respects. Sound level must be known in order to know how a particular machine will fit into its surroundings. When it comes to studying the noise produced by an individual machine, however, we must know the magnitude of each frequency component present in the sound. For this purpose, a sound analyzer is used. It is shown in *Fig.* 3 being applied to air conditioning equipment. The sound analyzer when used in connection with the sound-level meter, *Fig.* 6, enables the plotting of a chart such as the one in *Fig.* 4 showing the magnitude of each frequency component of the total noise.

The next procedure is to measure the vibration of the machine itself to make sure of the origin of the sound. For investigating the vibration of the machine, there are several devices available, all having their own advantages and disadvantages. A discussion of

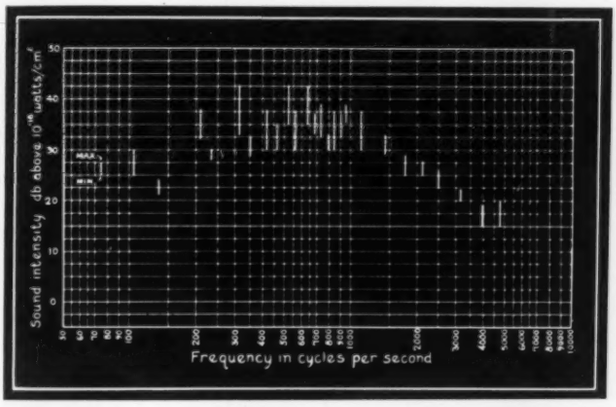


Fig. 4—Maximum and minimum intensity of each frequency component of total noise is plotted separately

each of these is beyond the scope of this paper (see Bibliography item 1) but in general a vibration-measuring device for noise analysis should have a wide frequency response and should not impose too great a load upon the vibrating object. These specifications are met by a vibration velocity meter such as the one shown in use in *Figs.* 1 and 5. This instrument responds to the velocity of the vibrating object. Those shown will cover a frequency range of 10 to 4000 vibrations per second and a velocity range of from 1 to 18,000 mils per second.

Instrument Available for Measuring Velocity

The question frequently arises as to why use velocity as an indication of magnitude of vibration. Fundamentally, a sinusoidal vibration can be completely described by giving frequency and either the displacement, velocity or acceleration. There shouldn't be any difference, therefore, between displacement, velocity or acceleration as either will tell what is going on. However, vibrations are rarely pure single frequency oscillations, and for investigating complex vibrations to determine their sound producing possibilities, either velocity or acceleration will give a more accurate indication than displacement. Thus, a high frequency vibration of small displacement may produce a lot more sound than a low frequency vibration having many times the displacement.

The vibration velocity pick-up unit can be used with the sound-level meter and analyzer to obtain a spectrum of vibration velocity for each component of frequency present. Results when plotted will be similar to *Fig.* 4 except the ordinate will be vibration velocity instead of sound level. The two frequency spectrum charts, one for sound level and one for vibration velocity, should line up fairly well. Any serious discrepancies should be investigated because they may indicate several things. For instance, if there are frequencies present in the sound spectrum which are not present in appreciable magnitudes in the vibration spectrum, it is obvious that there is a source of noise other than the particular part of the machine on which the vibration spectrum was made or that the machine is attached to a resonant base or other structure which is amplifying the otherwise negligible vibrations which do exist. The complete machine and supporting structure must be analyzed to make sure the vibration spectrum obtained is representative of what the machine is actually doing.

Sometimes the sound spectrum does not show any sound even though there is considerable vibration. This is fortunate if it occurs, but it should be remembered that changes made to eliminate other frequency components may bring these previously obscure frequencies back into the sound spectrum

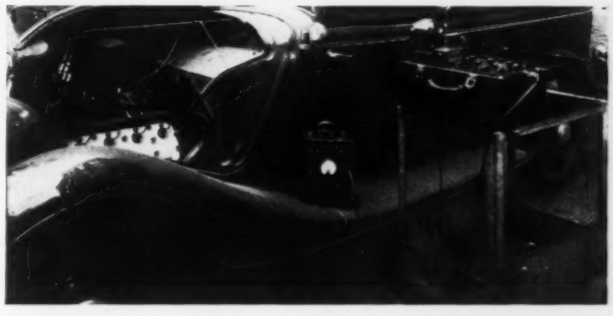


Fig. 5—Vibration velocity meter quickly isolates noise-producing vibrations in auto engine

because their absence indicates the presence of an anti-resonance or a critically balanced vibration which may be substantially altered by changes in structure. This enforcement of a previously inaudible noise component by changes to eliminate another component is not unusual in quiet machine design. It becomes exasperating at times but must be recognized as a distinct possibility each time a change in structure is made.

Occasionally other measuring tools prove useful in engineering work on noise. Foremost of these tools is the cathode ray oscillograph for use with a

velocity or other type of pick-up to obtain a visual picture of the displacement, velocity or acceleration wave shape produced by the vibration. With this visual inspection, any predominant frequencies will show up clearly. It is also easy to show up quickly any changes in performance resulting from addition of absorbent material, or changes in mountings, structure or damping. The effect of varying some factor such as the speed can be studied by making the change while watching the oscillograph. This equipment also permits determination of frequency by use of a known frequency sweep source. Amplitude of the visible wave can be measured and the relative amplitudes of higher frequency components can be observed in many cases with fair accuracy. Such equipment cannot displace the analyzer previously described, however, except to a limited extent. The chart of *Fig.* 4 is a picture of the magnitude of each frequency component present and is, of course, the

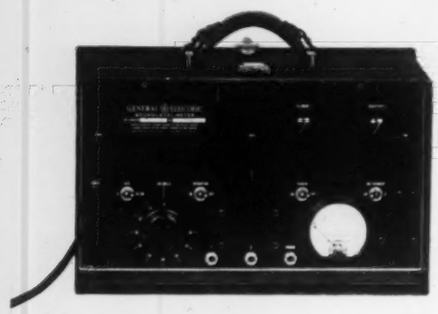


Fig. 6—Loudness of sound, expressed in decibels, is found by use of this instrument, the sound level meter

complete story especially since the various frequency components may arise from widely different sources. For that reason, it is well to have in mind each component as a separate entity. Of course, multiples of a single frequency usually go together so there are not so many different possible sources as there are lines in the frequency spectrum.

First in the use of the frequency spectrum chart, it is well to group together all multiples of a given frequency because each group probably represents a single source of vibration which when reduced or eliminated will reduce or eliminate each frequency component in the group.

Noise Frequencies Are Traced

The next step is to trace each group of frequencies to a particular vibrating source. Once this is done the analytical work is complete and the solution of the problem is often obvious. In general, if the noise component is high frequency, the vibration of the source must be eliminated or reduced to the point where it will not radiate directly to the air. If the component is low frequency, the part may sometimes be isolated by the use of resilent mountings preventing vibration being transmitted to its surroundings. In either case, the amplitude of vibration may be reduced by application of damping in the form of plastic materials, rubbing mechanical joints and the like.

Various methods which have been used to accomplish these objectives are given in the examples to follow. The number of solutions, however, is often limited only by the ingenuity of the designer.

Much Experience Already Gained

The fourth of the basic factors underlying quiet machine design is the experience already gained either directly or indirectly in producing actual results on previously noisy machines. The direct origin of a noise is a mechanically vibrating part or air stream; therefore noise reduction is essentially a mechanical engineering problem. It so happens, however, that electric equipment is frequently used in places where quiet operation is desired and a great deal of effort has already been expended in making operation more quiet. Many of the larger machines whether mechanical or electrical have had little or no attention from the standpoint of noise reduction because they are destined for factory use where noise levels are high.

In recent attempts to locate and reduce noise in a large reduction gear, the effect of the tooth shape is frequently studied by spectrum charts like *Fig.* 4 and in addition defective teeth may be found by comparing the fluctuation in noise with gear speed. Problems such as this emphasize the necessity for adequate measurements and tests. Any short cuts to avoid the relatively small expense of the measuring equipment introduce serious financial risk in the successful completion of the whole job.

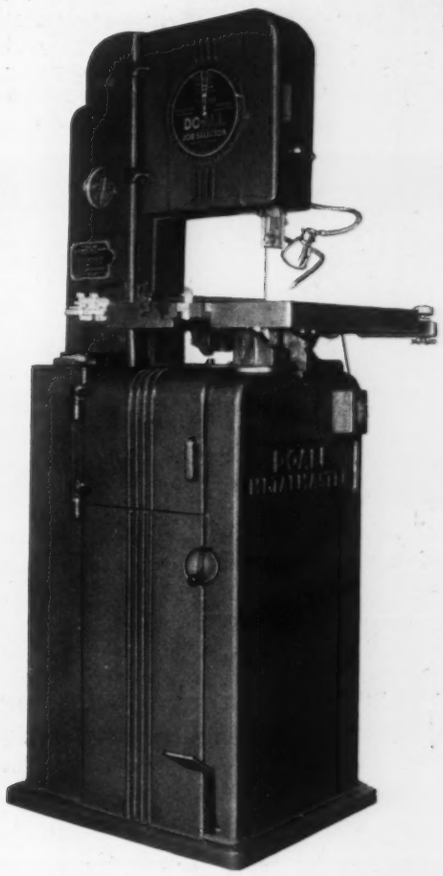
Noise In Autos Reduced Appreciably

Another illustration of progress in noise reduction has occurred in automobile design. A previous paper[3] in MACHINE DESIGN has outlined the various major steps in automobile noise reduction up to the advent of all steel body construction. The last change introduced a major problem in rumble because of the large metal panels involved. Special treatment of these surfaces has been made in the form of a stiffening rib work and sometimes in the application of an adhesive damping plastic to the interior surface. As a result, the new all-steel construction is less noisy on the whole than the older combination of steel, wood and fabric although the problem with all-steel construction is more severe.

A third illustration, partly familiar, contains a combination of practically all possible sources of noise so is given here again. This is the electric fan. Here turbulent air flows past the sharp edges of the fan blades. There is sliding or rolling friction in the

(*Continued on Page* 90)

Three Machines Built Into One!



Precision band sawing machine for die work and production metal cutting embodies advanced design ideas, including styling, instrumentation and units for welding blades and grinding welds

EVOLUTION of the band saw from a high speed woodworking machine into a production metal-working machine is an interesting phase of machine tool development and one of which the full implications have yet to be realized. A recent example of this is given by the precision machine designed by Continental Machine Specialties, Inc., Minneapolis, for the cutting of contours by the use of accurately guided narrow band saws; also for finishing of the work by means of file bands and its grinding and polishing by means of abrasive bands.

While based on the familiar conception of a standard band sawing machine, this Continental development embodies many advanced ideas in machine tool design, including features entirely novel in character. The frame is styled to clothe its inherent rigidity with lines and surfaces pleasing to the eye. Also important from the engineering point-of-view is its built-in instrumentation, which includes a "job selector" which is visible in the full length illustration of the machine —directly over the work gap.

This selector is a special form of double disk circular slide rule by which can be determined instantly the correct speed either for sawing or filing forty-eight different materials—together with correct pitch, temper and set of saw for cutting each one. For use in conjunction with this selector, a speed indicator is built into the column. This tachometer directly translates revolutions of the band wheels into cutting speed of the saw in feet per minute, from zero up to 800.

When cutting internal openings which do not extend through to the outside, it is necessary to break a continuous band saw in order to insert it through a starting hole in the work. To make possible quick and convenient reuniting of the band after this performance, there are built into the main machine two small auxiliary machines. One is a fully automatic electric butt welder of resistance type; the other is a power-driven grinder for preparing the ends of the saw prior to welding and for dressing the joints after welding. These "machines within a machine" are depicted clearly in the close-up view.

Action of the welding unit is dependent on movement of the saw-clamping terminals. This movement opens a circuit just as the steel at the point of weld reaches welding temperature. After the two ends of the saw are clamped in their respective terminals of the welder, a momentary contact switch closes the circuit and holds it until the weld occurs, whereupon the circuit is broken instantly by a toggle-mounted mercury switch. By means of a rotary tap selector switch, current is suited to the width of each blade.

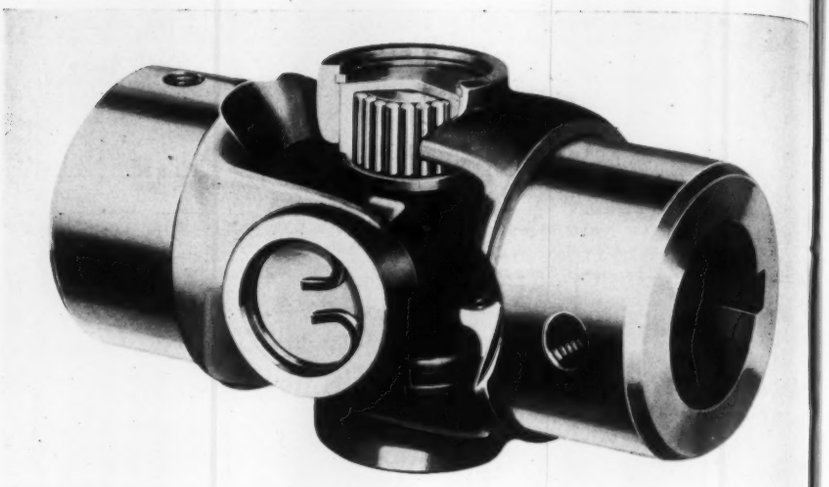


Fig. 1 — Application of needle bearings to an automotive type universal joint, showing simple and effective system of capping and retaining the rollers in minimum space

Compactness Is Primary Quality

By Guy Hubbard

NEEDLE bearings, through their common designation as such, suggest an origin far back in the history of mechanical development. That actually is true but the makeshift bearings of the early days—made up of sections of knitting needles or pieces of drill rods—were only the very remote ancestors of the highly refined small roller bearings to which the ancestral name still clings.

Not only does that old name still cling but unfortunately the idea still persists in the minds of some designers that the so-called needle bearing still is what it once was considered to be—a replacement for overloaded or underlubricated plain bearings, and one of somewhat dubious value. Even the crude needle bearings of long ago did help to solve problems of that nature, and the fine bearings of today are serving that purpose to a far greater degree.

The modern designer however, should think of these refined bearings—not as replacements—but as precision roller bearings of extraordinary compactness and dependability, which can be employed to great advantage in many difficult bearing points in new designs. Therefore, study of the possibilities of modern needle roller bearings is decidedly worthwhile.

It is significant that manufacturers of antifriction bearings have gone seriously into the design and manufacture of standard units of the needle roller type. This has broadened greatly the extent to which machinery can effectively and economically be antifriction-bearing equipped. For example, it now is possible and entirely practical to extend the use of antifriction bearings to details such as cam rolls, lathe centers, and wrist pins of internal combustion engines, through the application of properly selected standard units of needle roller type.

Generally speaking, needle bearings are particu-

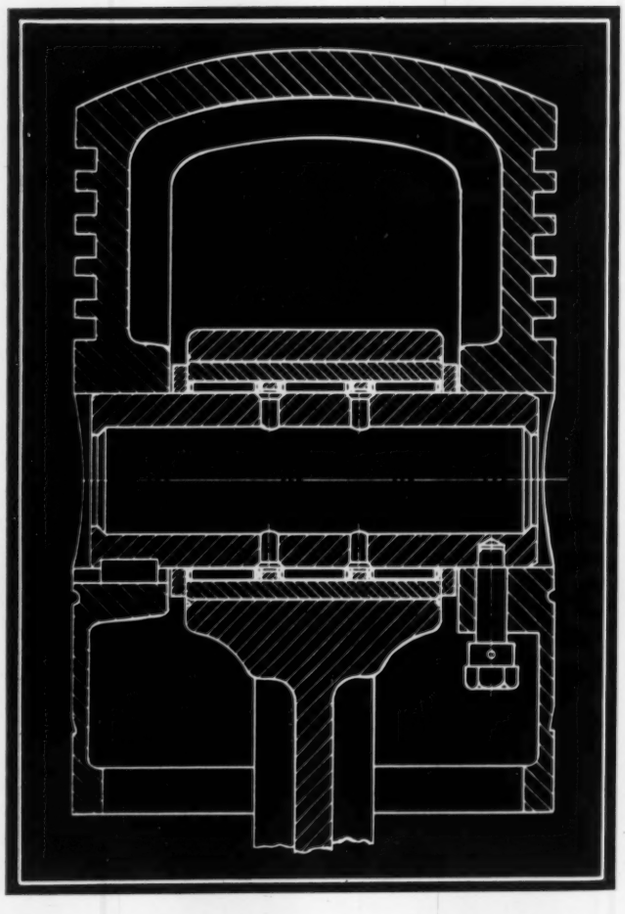


Fig. 2—Piston of a diesel engine, showing three-row needle roller wrist pin bearing oiled from within

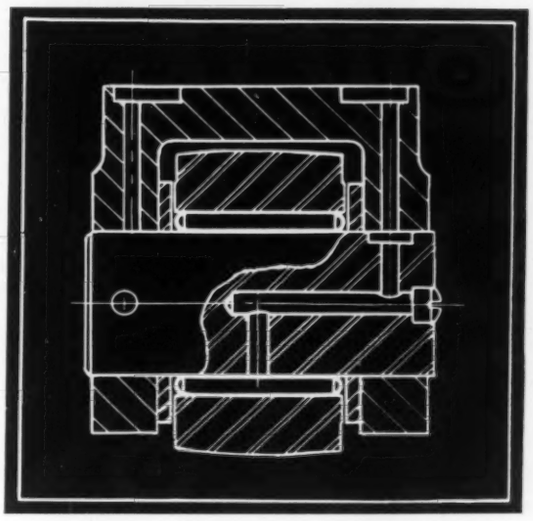


Fig. 3—Straddle-mounted cam roll, a design in which the hardened and ground roll itself constitutes the outer ring of the needle bearing assembly

ty of Needle Roller Bearings

larly well suited to applications where the speed is not high but where there are extremely heavy loads under static, oscillating or relatively slow speed conditions. Typical of such applications are those shown in *Figs.* 1, 2 and 3, which are successful needle roller applications to an automotive universal joint, to the wrist pin of a diesel engine, and to a cam roller mounted in straddle supports.

The universal joint is a good example of an installation in limited space, where care of the bearings is difficult on account of the location of the unit. Elimination of necessity for frequent servicing is an important feature in this case shown by *Fig.* 1.

In regard to the diesel engine wrist pin application depicted by *Fig.* 2, this is an example of an application which is much more common in European countries than is as yet the case in America. The design involves three rows of needle rollers separated by hardened and ground steel spacers, there also being hardened and ground steel spacers at each end of the complete assembly. Openings are provided at each of the two mid-positions for introduction of oil directly to the bearings.

The bearing set-up in the cam roller which appears as *Fig.* 3 is one now quite commonly accepted for use under a variety of similar conditions. It is noticeable here that the small diameter of the needle rollers make it possible to employ the desirable large diameter pin, at the same time allowing a relatively thick section in the cam roller itself. The roller constitutes the outer ring of the bearing and the heavy section is of course desirable to resist distortion. The assembly has high resistance against shock load due to the numerous points of support afforded by its large number of rollers.

In this instance means are provided for the intro-

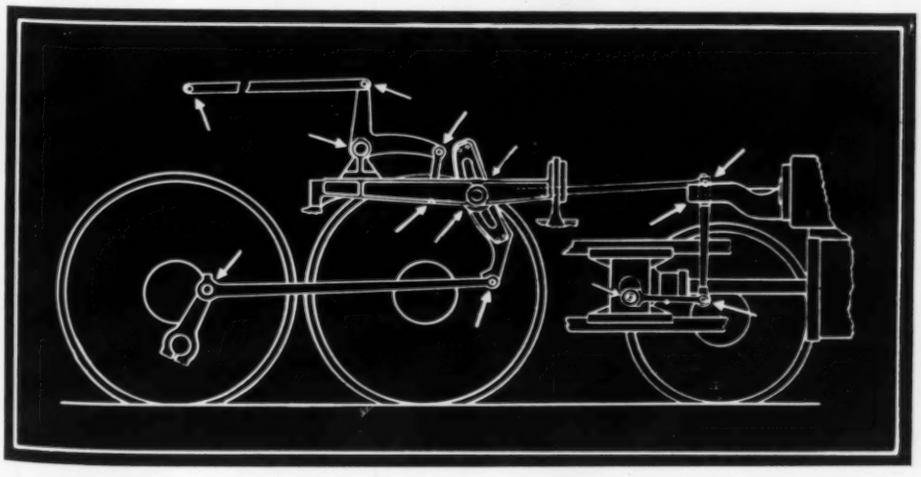


Fig. 4—Diagram of the valve gear of a conventional steam locomotive, the arrows indicating thirteen points where needle roller bearings are being used to advantage

duction of grease or oil directly to the rollers. The straddle supports are made in duplicate so that regardless of the direction in which the pin is inserted, the lubricant ducts will register properly with the openings in the pin.

Possibilities for needle roller bearings are by no means confined to machines of small size. One of the largest of machines—the steam locomotive—has turned out to be a fertile field for their successful use. This is true particularly of the modern locomotive valve gear and in the diagram, *Fig.* 4, thirteen points where needle bearings are being applied effectively are indicated by arrows.

A number of advantages have been gained in this case. Timing of the valves remains constant because backlash does not develop in service. Maintenance—particularly that of frequent lubrication—is largely reduced, lubricant being permanently sealed in. Continued uniformity of the performance of the needle roller bearing equipped engines is cited as proof of the effectiveness of this bearing equipment.

While on this subject of locomotives, it is interesting to note that the valve gear of the stainless steel streamlined steam locomotive recently developed for the Burlington railroad has needle roller bearings designed into its valve gear. A photograph of this valve gear unit is reproduced as *Fig.* 6. Two of the standard multi-roll bearing units can be seen in the ends of the lever arms, and the location of several others is obvious by the nature of the rocking joints.

Used in Concealed Door Check

Turning from very large mechanisms to very small ones let us consider now a device which may hardly have been thought of as a machine. This device is called an overhead door check and is one of those things which is noticed only when it fails to function properly Ordinary door checks are hung on the outside of the door, where servicing is relatively easy, but the one depicted in *Fig.* 5 is designed to be built into the head frame or transom bar.

To insure that it can be built in and literally forgotten, its designers have sought in every way to make it trouble-proof. An important factor in this effort has been the use of needle roller bearings—several sets of them being employed in this mechanism for supporting the case hardened and ground shafts.

An interesting example of the use of needle roller bearings under strenuous conditions of service is in connection with pumping units used in the oil fields. In designing a practical application for the upper end of a pitman rod, it was found impossible to depend upon accurate alignment of the large and heavy structural parts involved. Therefore, a ball and socket self-aligning housing was developed along the lines shown in *Fig.* 7.

The two needle roller bearings used in this housing are in themselves complete self-contained units comprising both inner and outer rings. These have been spaced well apart in order that the aligning force operating on the ball and socket assembly shall be in the nature of a radial load as far as the bearings are concerned.

Protection for Floating Bearing

To protect these bearings against the difficult weather and dust conditions under which they must work, rawhide seals are mounted on each face of the housing. The lower end of the pitman rod is definitely located and the clearance which has been allowed at each end of this upper bearing allows the necessary float to insure proper positioning.

The provision for pressure lubrication is quite obvious in the illustration. The wide spacing of the two sets of bearings has a further desirable effect in that it provides within the bearing structure a lubricant reservoir of generous size. This is important on a "rough-and-ready" mechanism of this nature where replenishment of the lubricant may sometimes be overlooked for some little time.

Steel mill service is reputed to be about as "tough" as any to which precision machinery ordinarily is subjected, but even there places have been found where needle roller bearings have definite possibilities. A case in point is their application to the necks of rolling mill rolls. In one successful design, which is not illustrated here, two sets of short needle rollers are used on each roll neck, these being rather widely spaced. These take radial load only, end thrust being taken care of by a deep groove ball bearing at the outer end of each neck.

An interesting feature of this design is the simple method employed for handling the needle roller bearings during assembly and disassembly. These bearings sometimes are rather difficult to handle on ac-

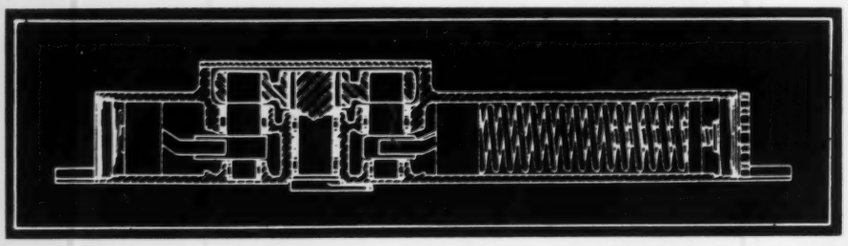


Fig. 5. Designed to be built into the door frame, this overhead door check is equipped throughout with needle roller bearings to minimize service attention

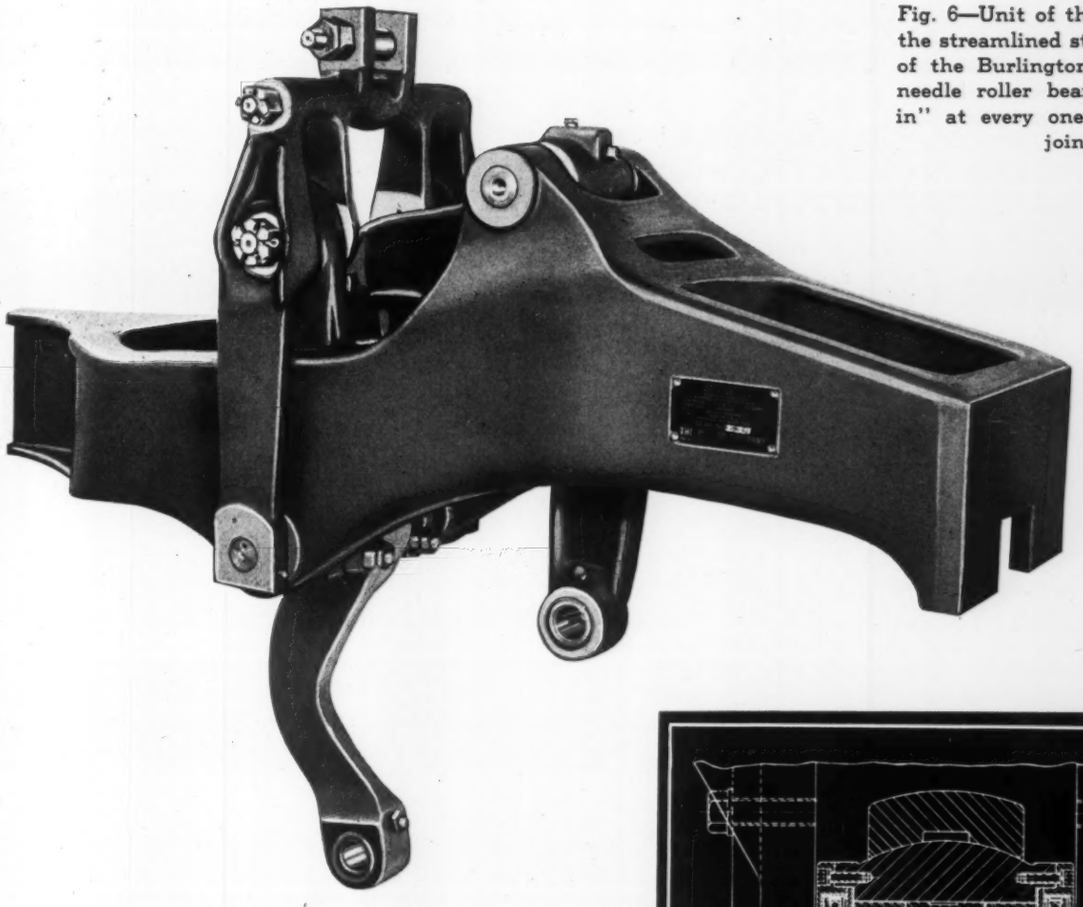


Fig. 6—Unit of the valve gear for the streamlined steam locomotive of the Burlington railroad, with needle roller bearings "designed in" at every one of its rocking joints

count of the tendency for the rollers to get out of position. To prevent that a dummy sleeve is provided which is of the same outside diameter as the inner races of the bearings. This is put on over the end of the roll neck and the chuck carrying the rollers is slid out upon it, allowing handling of the units without possibility of rollers dropping out of place.

Applications Are Widely Varied

Even though the possibilities of needle roller bearings are not as yet as well known to designers as they are destined to be in the not far distant future, a recital of successful applications already made could go on to considerable length. It would include brush cam rollers and valve rocker arms of internal combustion engines; cam follower rollers of high speed printing presses; main bearings of sewing machines, bread slicing machines, and gear-type oil pumps; supporting bearings for automobile transmission countershafts; and the main and connecting rod bearings of small gasoline engines.

It is significant that there is hardly an automobile built today which does not contain some needle roller bearings, and most of the cars contain many of them. Design details which have been found to be efficient in automotive service and to "stand the gaff" imposed by that service invariably are worthy of serious consideration by designers of other types of machinery.

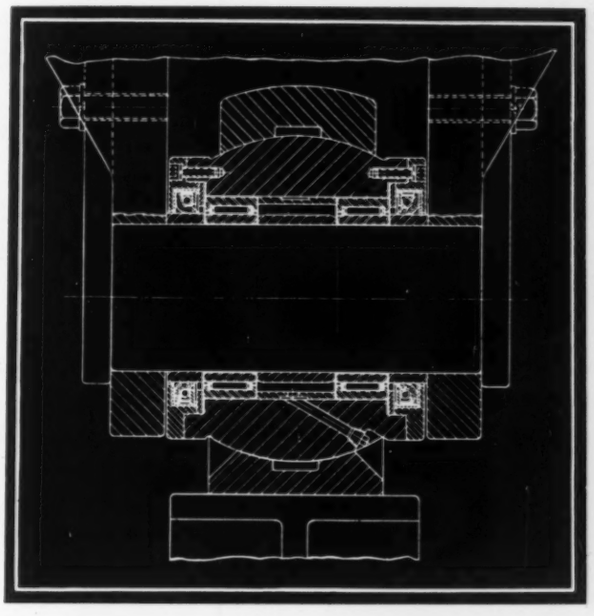


Fig. 7—Self-aligning housing for needle bearings used on upper end of pitman rod of oil pumping rig

Metallurgists and machine tool builders deserve much credit for the present excellence of needle roller bearings—the former for the development of alloy steels suitable for the races and rollers, the latter for the development of grinding machines for the precision finishing of these elements.

In the preparation of this article valuable help has been given, both in the way of data and illustrations, by the following: The Bantam Ball Bearing Co., McGill Mfg. Co., Norma-Hoffmann Bearings Corp., the Pilloid Co., the Oscar C. Rixson Co., the Spicer Mfg. Corp., and The Torrington Co.

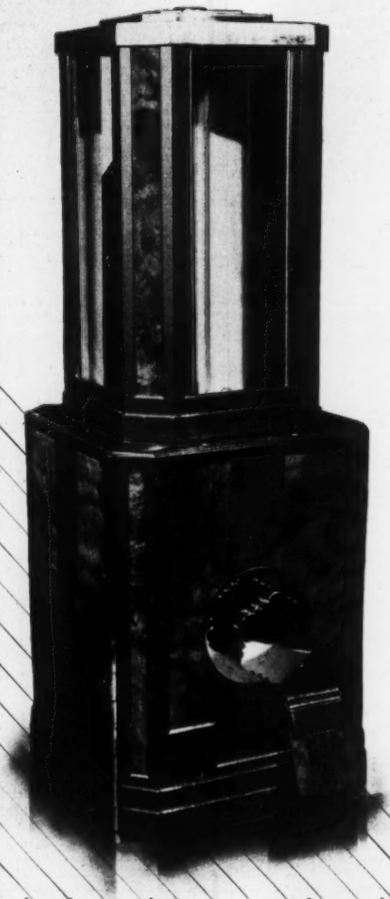
One-piece casting keyed, bolted and doweled to the base insures exceptional rigidity of the vertical member carrying the sliding head in the Gallmeyer & Livingston grinder, above. Direct motor-driven spindle runs in precision ball bearings

Precisely made to give exact readings the Taber abraser, right, is designed to measure wear resistance, toughness and adhesion qualities of surface finishes. Power-driven specimen holder revolves against two small wheels of abrasive composition causing rubbing action comparable to the wear materials ordinarily receive

Uniform sou
are projected
zontal plane
intensity in al
in the nove
radio, right,
sembles a tra
of furniture.
cone and baf
upward soun
horizontal

Design Fe
In New M

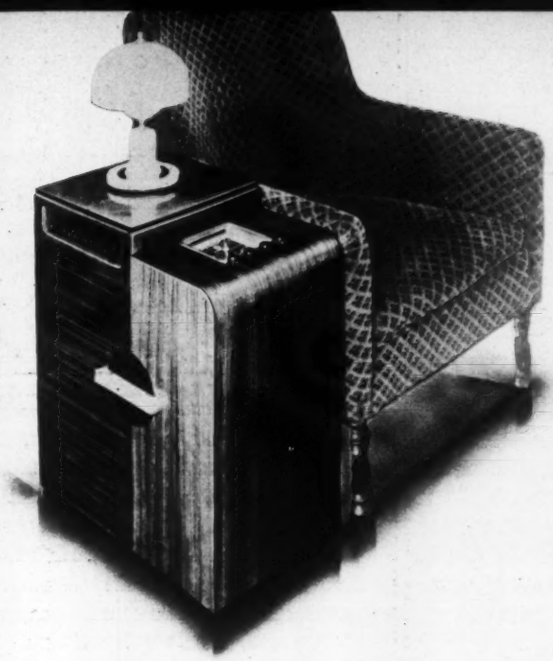
**A Pictorial Presentation o
from the Standpoi**

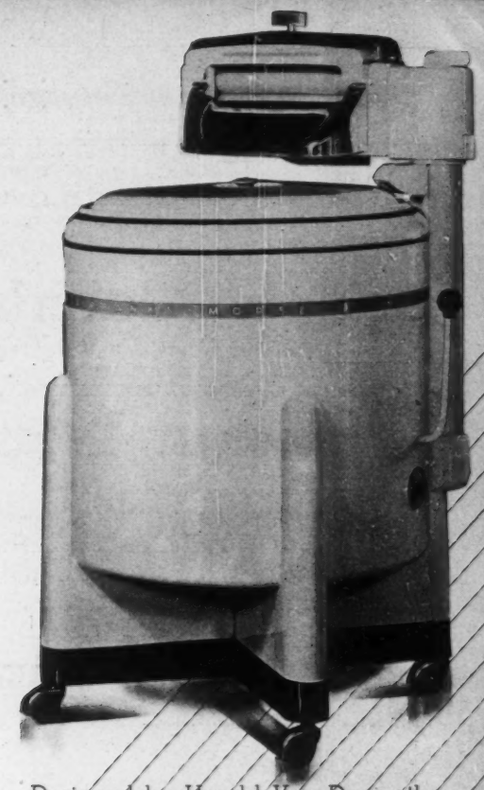


Art finish simulating grained wood distinguishes the Stewart & McGuire peanut vending machine, above. Hopper bottom is of aluminum and the sides, glass frame and other parts are zinc base die castings

Water temperature in the Barsope lather mixer, below, is thermostatically regulated. Small motor built into cast aluminum body delivers lather in few seconds, properly mixed and heated

iform sound waves
projected in a hori-
tal plane with equal
ensity in all directions
the novel Kadette
io, right, which re-
bles attractive piece
furniture. Auxiliary
e and baffle turn the
ward sound waves in
orizontal direction



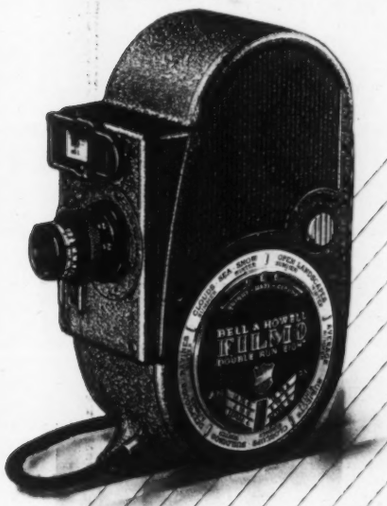


Designed by Harold Van Doren the Fairbanks-Morse washing machine, above, combines utility and beauty. White baked enamel finish with black and chrome trim gives pleasing appearance, and special cradle type base offers unusual strength

Features
Machines

tation of Recent Machinery
tandpoint of Design

Eye appeal and compact appearance are obtained in the Bell & Howell movie camera, below, by extending sweeping lines around contour of camera. Utilizing eight millimeter film enables the camera to hold more footage than larger units employing wider film



Excess energy in clock spring of the Miller parking meter, left, is used for driving flag mechanism and issuing customer's receipt. Iridescent color lacquer over a baked wrinkle under coating gives durable and attractive finish

Hydraulic mechanism, electrically controlled, raises and lowers drill unit on the improved Challenge paper drilling machine, right. If control pedal is released during drilling operation, the drill immediately returns to starting position

New Machines Indicate Design Trends

RIGIDITY, elimination of excess parts and quick assembly are obtained by utilizing a minimum number of separate castings or welded components in a machine. Motor-pump units are employing a single casting for the motor support and the pump casing, thus obviating the need for an extra bearing and coupling. Gearmotors, almost since their inception, have utilized a single casting for the motor housing and for the reduction gearcase. Of course, in large machines the very nature of the construction will not allow a single casting to suffice, but designers find that advantages may be gained by employing separate complete assemblies. In the Gallmeyer & Livingston grinder, shown on the preceding pages, two heavy castings are keyed, bolted and doweled together producing a machine as rigid as one constructed from a single casting. Another example is that of an air cylinder built for heavy duty, in which strength and rigidity are produced by threading the cylinder and head, screwing them together, then welding them.

Air Conditioning

Radial type compressor, Airtemp Inc., Dayton, O.
Portable air conditioner, Star Radiator Co., Los Angeles.

Brewery

Barrel washer, John S. Oram Co., Cleveland.

Construction

Concrete mixer, Ransome Concrete Mixer Co., Dunellen, N. J.

Domestic

Oil burner, Autocrat Oil Burner Corp., Cedar Rapids, Ia.
Furnace, Peerless Foundry Co., Indianapolis.
Automatic record player, Sound Products, Hollywood, Calif.
Bin-feed fire tender, Holcomb & Hoke Mfg. Co., Indianapolis.

Dry Cleaning

Revolving iron, Cleaners Appliance Co., Des Moines, Ia.

Electrical Equipment

Heavy duty drill, The Black & Decker Mfg. Co., Towson, Md.

Excavating

Blast-hole drill, Bucyrus Erie Co., Milwaukee, Wis.
Feeder-crusher, Universal Crusher Co., Cedar Rapids, Ia.

Finishing

Automatic metal finishing machine, Paasche Airbrush Co., Chicago.

Food

Electrically operated juice extractor, Veg-O-Mat Machine Co., New York.
Ice cream vending machine, Ice Cream Venders Inc., New York.

Foundry

Aerator and sand conditioner, Eastern Corp., New York.

Materials Handling

1—1½ ton truck, Diamond T Motor Car Co., Chicago.
Large capacity hauling truck, Mack Trucks Inc., Long Island City, N. Y.
Hi-lift electric hoist, Northern Engineering Works, Detroit.

Metalworking

Wrapping type bending roll, Kane & Roach Inc., Syracuse, N. Y.
Die making machine, Frank W. Hack, Chicago.
Spring making machine, Torrington Mfg. Co., Torrington, Conn.
High speed ram type shaper, Rockford Machine Tool Co., Rockford, Ill.
Plain cylindrical grinding machine, Brown & Sharpe Mfg. Co., Providence, R. I.
Variable speed grinders, Safety Grinding Wheel & Machine Co., Springfield, O.

Office

Duplicator, Elman Sales Co., Chicago.

Packaging

Paper shredder, Manufacturing Distributors Co., East Orange, N. J.
Singlehead automatic capper, Pneumatic Scale Corp. Ltd., Quincy, Mass.

Printing

Magnetic spot coater, Chas. Wagner Machinery Co., Hoboken, N. J.

Clipper model cabinet pedestal saw, J. A. Richards Co., Kalamazoo, Mich.

Restaurant

Electric cube steak machine, Cube Steak Machine Co., Boston, Mass.
Cabinet dishwasher, Westinghouse Electric & Mfg. Co., East Pittsburgh.

Refrigerating

Portable refrigerator, The Guest Box Co., Middletown, O.

Rubber

Rubber sheeting mill, Farrel-Birmingham Co. Inc., Ansonia, Conn.
Tire spreader, Bishman Co., Minneapolis.

Textile

Swing tenter, Textile Finishing Machinery Co., Providence, R. I.
Standard extractor, Fletcher Works, Philadelphia.

Welding

Air-operated spot welder, Eisler Engineering Co., Newark, N.J.
Automatically-controlled spot welder, Armglo Co., Milwaukee.

Woodworking

Automatic turning sander, J. M. Nash Co., Milwaukee.
Band saw filer and setter, Black Diamond Saw & Machine Works, Natick, Mass.

Cut-and-Try Methods Should be Supplemented by New Design Equipment

SEVERAL relatively new devices which might well be classed "tools of the designer" are becoming increasingly important in engineering department work. Among these should be included noise meters and analyzers, photoelastic equipment, stroboscopes, and high-speed motion picture cameras. Adjuncts to design and development such as these have been used for some years by a few of the larger machinery manufacturing companies; it has only been since financial pressure eased, however, following the darker days of the depression, that smaller concerns have evinced particular interest in their use.

Of the devices mentioned, noise measuring equipment is undoubtedly receiving the most attention at this time. Engineers have been in the habit of trying to develop a quiet machine by the application of certain fundamental principles such as might be used in the determination of stresses. This is satisfactory as far as it goes—but it does not go nearly far enough for present-day purposes.

Without the use of instruments it is extremely difficult to obtain the necessary results. Furthermore, experience in noise analysis coupled with knowledge of the design of earlier models of the machine under development is desirable, as will be evident from a reading of the article on elimination of noise which appears elsewhere in this issue.

Second in importance at this time among the instruments under discussion seems to be photoelastic equipment. Design engineers are rapidly recognizing the value of scientific observation and study of stress. Third and fourth in order are the stroboscope and high-speed camera respectively.

It is unquestionable that each of these devices as well as noise testing instruments is destined to play a major part in the design work of the future and consequently will sooner or later be considered as part of the standard equipment of the engineering department.

• • •

Classified Advertisements

WITH this issue, MACHINE DESIGN institutes a classified advertising section to include positions available and positions wanted. It will appear on one of the four pages immediately preceding the index to advertisers.

As an additional service to readers we are confident this department will meet with immediate acceptance. The thought is not to encourage changes in positions, merely for the sake of change, but rather to bring to the attention of readers the availability of types of work for which their qualifications might admirably equip them and, conversely, the availability of suitable men. Often a "square peg in a round hole" is a detriment to employer and employe alike, with resultant absence of efficiency and harmony.

In order to be of the utmost value, the section has been founded on a concrete, high standard basis. It will be our earnest endeavor to have it perform its function to the satisfaction of all concerned.

MEN of MACHINES

ANNOUNCEMENT recently has been made of the appointment of Dr. A. Allan Bates as manager of the chemical and metallurgical division of the Westinghouse Research Laboratories. He had previously been professor of metallurgy at Case School of Applied Science and was consultant for a number of companies in the Cleveland area.

Dr. Bates graduated from Ohio Wesleyan in 1923, afterwards attending Case School where he gained his B.S. degree in metallurgy. During 1930 and 1931 he was in France attending the Ecole de Metallurgie of the University of Nancy, where he received his Doctor's degree in metallurgy. Prior to joining the Case faculty, Dr. Bates was employed by the National Tube Co. and was research metallurgist for the National Malleable & Steel Casting Co.

A. ALLAN BATES

• • •

PROMOTION of E. B. Newill to be assistant general manager of Frigidaire division, General Motors Corp., marks the ascendancy of a man of research type broadened by experience in production and sales.

Born at Atlanta in 1895, Mr. Newill graduated from Georgia Institute of Technology in 1915 with degrees in both mechanical and electrical engineering. He immediately went to Westinghouse Electric & Mfg. Co., East Pittsburgh, where he served under B. G. Lamme. There he remained for fourteen years, developing automotive electric equipment, as supervisor of engineering budgets, and finally in charge of the industrial control department. Mr. Newill came to Dayton in 1929 as vice president in charge of engineering of General Motors Radio Corp. and had been chief engineer of Frigidaire since June, 1930.

E. B. NEWILL

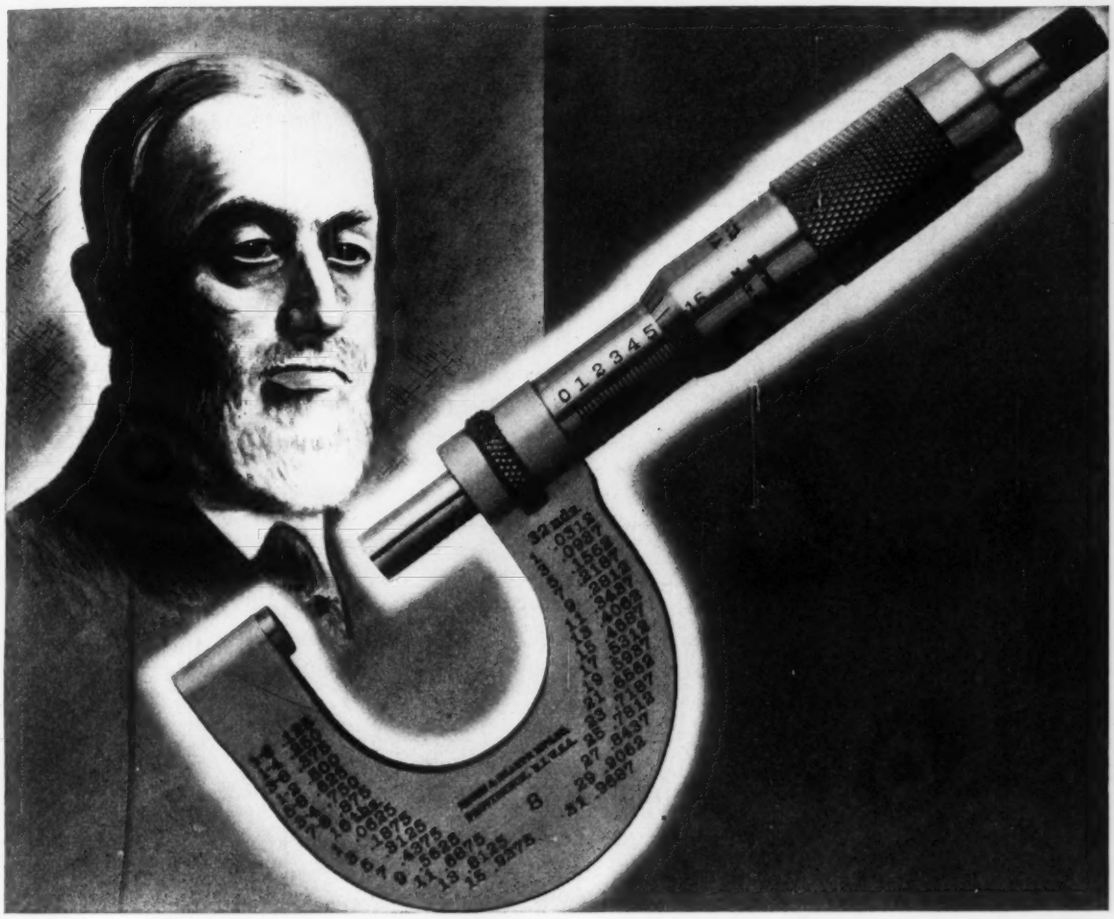
• • •

HOWARD DINGLE, president of the Cleveland Worm & Gear Co., who now is vice president of the American Gear Manufacturers' association, "followed through" on his engineering education by getting practical experience in a manufacturing machine shop.

Mr. Dingle was born in Asbury Park, N. J., and attended Cornell University, where he specialized in electrical engineering, graduating in 1905. Following graduation he went with the Crocker-Wheeler Electric Mfg. Co. at Ampere, N. J., starting as a workman in the shop. Eventually he was sent to Cleveland as a sales engineer. For seven years he was Cleveland district manager for Crocker-Wheeler. With W. W. Clark he later organized the Dingle-Clark Co., contracting engineers, of which company he is vice president. Mr. Dingle became connected with the

HOWARD DINGLE

MODERN MACHINE ACCURACY DEPENDS ON SUPER-PRECISION



● When Lucian Sharpe first introduced his newly invented micrometer caliper, the market for such an instrument appeared quite limited. Few industries then required such accuracy. Yet today greatly improved micrometers are found in every machinist's tool box.

While the modern micrometer has an important part in the manufacture of thousands of products with a high degree of accuracy, many modern machines are built to tolerances of 1/10,000th of an inch or less. For checking such extreme accuracy, optical gauges and other types of precision instruments are used.

Since the accuracy of any rotating part depends on the accuracy of its bearings, M-R-C Super-Precision Ball Bearings have their race grooves, outside diameter, and bore held to concentricities of 1/10,000th of an inch. The balls are accurate in size and roundness within 1/100,000th of an inch.

The results of such precision methods of manufacture are two-fold. First, they give long bearing life at extremely high speeds and under heavy loads, and second, they permit a finer surface finish on the work than can be attained by any other means. That is why *where machine tool speeds are high and fine surface finish is important, you find M-R-C Super-Precision Ball Bearings.*

MARLIN-ROCKWELL CORPORATION

Executive Offices: JAMESTOWN, N. Y.

Factories: JAMESTOWN, N.Y. . . . PLAINVILLE, CONN.

M-R-C SUPER-PRECISION BALL BEARINGS ESTABLISH NEW STANDARDS OF ACCURACY

M-R-C *Ball Bearings*

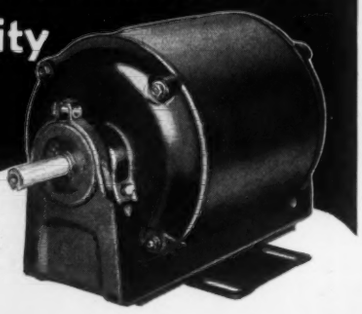
GURNEY ● SRB ● STROM

Wagner Motors

Are Outstanding

For Their

Good Performance and Dependability



Motor dependability means the ability of the motor to provide unfailing service; good performance means the ability of the motor to satisfactorily and efficiently meet the load requirements of its application. Because Wagner motors possess these qualities as demonstrated on hundreds-of-thousands of motor applications, they have won the approval of users everywhere.

These qualities in Wagner motors are not accidents, but are specially built into them . . . built into Wagner motors by better design, better materials and better methods of manufacture . . . Yes, at a slightly higher cost to the motor manufacturer — but Wagner policy forbids any economy which is destined to result in a higher cost-per-year service to the motor user. Weigh these factors when considering your next motor purchases. Wagner motor bulletins will be sent upon request.

MM237-2J

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS • FANS • TRANSFORMERS • BRAKES

Cleveland Worm & Gear Co. in 1924 as general manager and has been president of this company since 1927. In the days of the NRA he was vice chairman of the Code Authority of the Gear Manufacturing Industry.

Mr. Dingle's service with the American Gear Manufacturers' association has included the chairmanships of the Commercial, and Worm Gear Speed Reducer committees. In the latter connection he has been active in promulgation of the A.G.M.A. recommended ratings for speed reducers.

♦ ♦ ♦

ARNOLD P. YERKES, International Harvester Co., was elected president, American Association of Agricultural Engineers at the annual meeting held recently at the University of Illinois, Urbana, Ill.

♦ ♦ ♦

I. D. APPLEGATE has been placed in charge of engineering, design and development of automatic voltage, current and speed regulators for Ideal Commutator Dresser Co., Sycamore, Ill. Mr. Applegate was formerly with Westinghouse Electric & Mfg. Co..

Obituaries

MAJOR ROBERT ALEXANDER BULL, noted foundry consultant and past president and honorary member of the American Foundrymen's association, died in Anniston, Ala., July 29.

Major Bull was born in New Albany, Ind., in 1874. He attended Depauw University, graduated from Butler University with a bachelor of arts degree and subsequently received his master of arts degree from St. Louis University.

His early industrial experience was with Robert W. Hunt & Co. Later he held important positions with the Leighton & Howard Steel Co., American Steel Foundries, Commonwealth Steel Co., and the Chicago Steel Foundry Co., having been vice president and general manager of the last two. Commissioned major, Ordnance department, U.S.A., he served in the division of construction and maintenance, A.E.F.

Major Bull, who was the author of many technical papers, was a valued contributor to MACHINE DESIGN.

♦ ♦ ♦

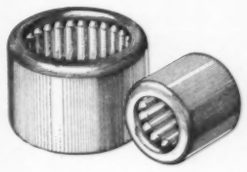
GEORGE R. BOTT, 58, chief engineer and a director of the Norma-Hoffman Bearing Corp., Stamford, Conn., died at his summer home in New Canaan, Conn., Aug. 14.

Mr. Bott, who was born in Columbus, O., graduated from Ohio State University, class of 1901. He joined the Norma-Hoffman company about 25 years ago. He was one of the pioneers in the antifriction bearing industry and held several patents of importance in that field.

This new bearing offers special Advantages *in* Rotary Applications

COMBINING the advantages of a complete anti-friction bearing in a small compact unit requiring no more space than a plain bushing, the new Torrington Needle Bearing offers outstanding advantages in many types of rotary application.

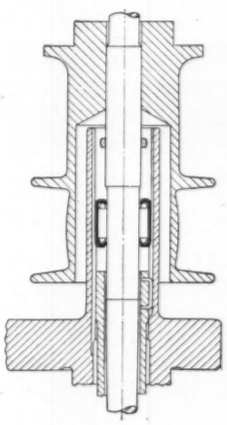
In addition to small size, high radial load capacity, ease of installation and low cost, other advantages of this new Needle Bearing, as illustrated below, contribute to general simplification of design with resulting increase in product efficiency and reduction in manufacturing costs.



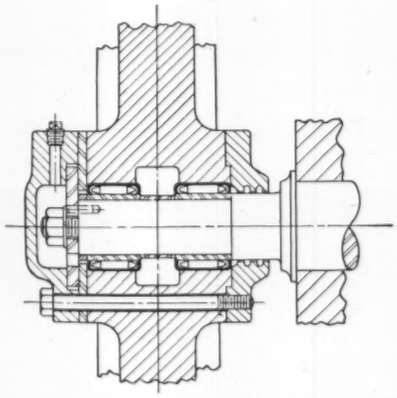
ITS SMALL SIZE, HIGH UNIT CAPACITY, EFFICIENT LUBRICATION, AND SAFE OPERATION AT HIGH SPEED DESERVE CAREFUL CONSIDERATION

Textile Spinning Spindle

Textile spinning spindles operate at high speeds 24 hours per day for long periods. Any fractional savings in power consumption secured through the use of this anti-friction bearing results in considerable saving in power costs per year. Ability of the Torrington Needle Bearing to operate continuously at high speeds with minimum of lubrication or other service attention gives further operating economies.

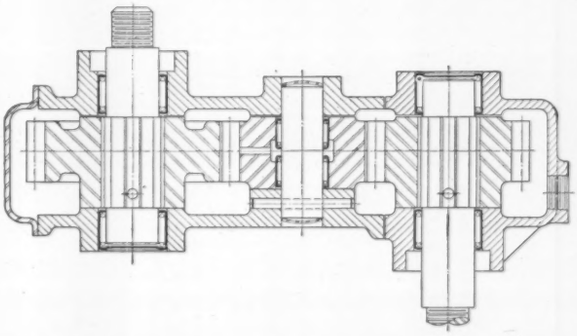


Truck Wheel



The industrial truck wheel is another common rotary application where the anti-friction principle of the Torrington Needle Bearing offers advantages. Low coefficient of starting and running friction, small size, need for only occasional lubrication, and design of the unit which seals against dirt, dust and foreign matter combine to make the Needle Bearing ideal in applications of this type.

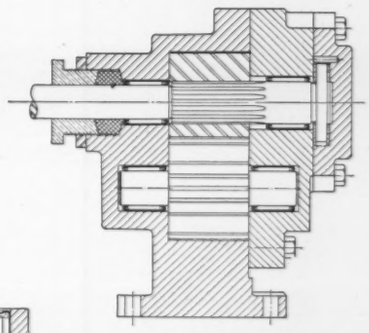
Power Mower Transmission



Use of the Torrington Needle Bearing in a power-driven mower transmission has greatly increased the time interval between repairs. The application of this new type anti-friction bearing to the typical horse-drawn mower also greatly reduces the draft of the machine.

Floating Gear Pump

The top drawing shows the application of Torrington Needle Bearings in a floating gear pump. In a rotary pump of this type where loads may be extremely heavy, there is no danger of taxing the capacity of these bearings. Small size of the Needle Bearing allows the use of small



diameter rotors and permits adequate metal around the bearings to provide a sturdy housing and end shield without excess bulk or weight. Likewise, because of the small space required for the Torrington Needle Bearing, larger diameter shafts may be used, cutting down distortion from the heavy pressures involved. Our engineering files record many more applications where the Torrington Needle Bearing offers advantages. A representative of our engineering department will be glad to work with you in both preliminary investigation and in planning designs in detail. Additional information is given in our Catalog No. 9, available on request.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Branch Offices in all Principal Cities

TORRINGTON
NEEDLE BEARING

AIR « « OR HYDRAULIC

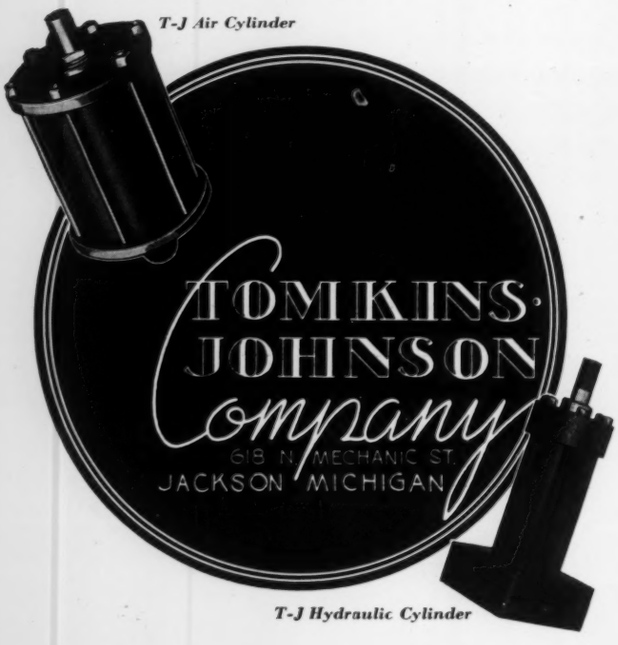
Keep abreast of the trend . . . let these two new catalogs assist you in solving your problems related to the use of Air or Hydraulic equipment. Every designer of machinery should have both publications for ready reference because they contain complete engineering data.

Request today Catalog No. H37 on hydraulic devices and No. 36 which covers air equipment.

Better T-J Hydraulic cylinders mean better performance. Or if Air Cylinders are preferred, T-J Air Equipment also meets the exacting requirements that modern industry is demanding of machinery embodying equipment of this type.

These catalogs will help you select the cylinders, valves, chucks, and special equipment which you require.

T-J Air Cylinder



T-J Hydraulic Cylinder

Noteworthy Patents

MECHANISM for the waxing of paper in such a manner that there will be a highly lustrous and smooth coating of wax on one side of the paper only, has been covered by patent No. 2,083,273, granted to Charles H. O'Neil. This has been assigned to the Nashua Gummed & Coated Paper Co. of Nashua, N. H.

To show the method followed, a simplified longitudinal section of the mechanism in operation is presented herewith as *Fig.* 1. Paper is fed from a roll at the right end of the machine, passing over a guide roll and then between a rubber squeeze roll and a steel-surfaced coating roll. The latter, which is the lower one of the pair in the main frame of the machine, runs in a tank of melted wax which thus is fed to the lower surface of the web of paper.

From these two rolls the paper passes over a burnishing roll which is driven in a direction opposite to the travel of the paper. To preserve the high finish which is imparted by this burnishing roll the web of paper next passes around a roll which is partially submerged in a tank of water — the water being maintained at a predetermined level by means of the overflow which can be seen at the left of the submerged roll.

In passing under this roll a small arc of the web of paper passes through the water bath, which sets the wax coating. Being in close contact with the roller, the uncoated back of the paper does not be-

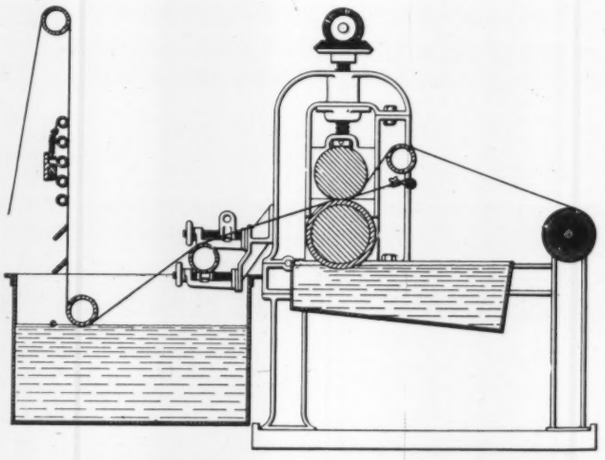


Fig. 1—*Paper coating machine is designed to apply wax smoothly and only to one side of the sheet*

A thousand different bronze alloys . . . yet only one offers the utmost in qualities of

★ WEAR RESISTANCE
★ TENSILE STRENGTH
★ CORROSION RESISTANCE

WEIGHING 3% less than steel and from 8% to 20% less than bronze, Ampco Metal has a tensile strength ranging from 60,000 to 100,000 pounds per square inch.

Possessed of a stubborn resistance to breakage, deformation, and fatigue, Ampco Metal performs where other metals fail . . . in parts subject to heavy loading and requiring maintained accuracy . . . in difficult bearing, nut and gear services . . . for forming and drawing dies, where it is superior to hardened tool steel.

Besides extraordinary wear resistance Ampco Metal offers another virtue . . . high resistance to corrosion by the common commercial acids, strong alkali and salt solutions, super-heated steam, and the effects of weather as well. Valves, liners, crates, racks and chains are indicated uses for Ampco Metal.

Ampco Metal is available in six grades of varying hardness and physical properties . . . the book "Ampco Metal—Its Uses in Modern Industry" will interest you.

AMPCO METAL, INC.
Dept. MD-9, Milwaukee, Wis.

PROPERTIES OF AMPCO METAL — GRADE 16

NOTE: Grade 16 is one of the most widely used Ampco alloys. Its prime fields of service are bushings, bearings and gears.

Ultimate Tensile Strength (lbs. per sq. in.)	70,000 - 80,000
Yield Point (lbs. per sq. in.)	32,000 - 37,000
Elongation % in 2 inches	18 - 22
Red. of Area % in 2 inches	16 - 20
Brinell Hardness 3000 Kg. load	137 - 149
Rockwell Hardness	78 - 80-B
Scleroscope Hardness	24 - 26
Young's Modulus	15,385,000
Charpy Impact Value	28.3
Mean Analysis % Copper	86.20
Mean Analysis % Aluminum	10.20
Mean Analysis % Iron	3.30
Mean Analysis % Special Agents	0.30
Weight lbs. per cubic inch	.275
Applications—	Bushings, Gears, Machine Parts

AMPCO METAL

"The Metal without an Equal"

BEFORE YOU SPECIFY . . . INVESTIGATE AMPCO

With this **NEW** *low-cost printer*

SIMPLE • COMPACT • CONTINUOUS

● So compact that it can be placed on a desk top, this new Model 3 Bruning Printer exposes BW (black and white) Prints or blue prints up to and including 42 inches in width. Plugs into an ordinary light socket—built for 110 A.C. or 110 D.C.

ELIMINATES CUMBERSOME EQUIPMENT

● Used with any one of Bruning's BW Developing Machines, the Model 3 Printer provides a complete BW exposing and developing unit. You can eliminate cumbersome equipment—for BW Prints require no washing or drying . . . no space-wasting tanks and dryers.

MODERATE PRICE • LASTING VALUE

● Moderately priced ($295 for 110 A.C., or 110 D.C.), the Model 3 BW Printer will bring new efficiency to your print room whether you use it for exposing BW Prints or blue prints. Mail the coupon for full details about the Model 3 Printer, and about Bruning BW Developing Machines.

BRUNING *Since 1897*

New York Chicago Boston Detroit Houston St. Louis Newark Los Angeles Kansas City Milwaukee Pittsburgh San Francisco

CHARLES BRUNING CO., INC., 102 Reade St., New York, N. Y.

Gentlemen: Please send me details about the Model 3 BW Printer and Bruning BW Developing Machines.

Name.....

Company.....

Address.....

City..... *State*..... 824

come wet. Adhering water is removed from the waxed surface of the paper by squeegee blades and suction rolls which are arranged between the submerged roll and the take-off roll over which the web passes before rewinding.

For many applications it is desirable to have one or both of the margins of the paper entirely free from wax. This is accomplished by means of light steel tapes anchored to a cross piece under the guide roll, and extending between the rubber and coating roll, around the submerged roll and thence over the top suction roll to a spring anchorage behind it. The mounting of these steel tapes, which protect the margins from both wax and water, can be seen in the cut.

Jaws Grip Round Belt

FIRM gripping of a driving rope, belt or cable is the end sought in a recent invention by Leo J. Vogel of Pittsburgh, which is covered by patent No. 2,076,687. The invention is embodied in a pulley of unique construction, which is suitable either for the driving or the driven member.

The drawing, *Fig.* 2, shows the use of this pulley in connection with a rope or round belt drive. It will be noticed that the operating mechanism for the grippers is something like the valve mechanism of a radial aircraft engine. The pulley itself is of the familiar grooved or V-type. On each spoke there is mounted a push rod at the lower end of which is a roller riding on a circular cam. Springs keep these rollers in contact with the cam at all times. The cam is fixed to a support and does not revolve with the pulley or pulley shaft. In other words, the gripper operating mechanism revolves around the cam as the pulley turns.

In the case of the grippers, the automotive valve analogy still holds. They are similar to the rockers of an overhead valve system. As is clear in the drawing these grippers are pivoted at the edge of

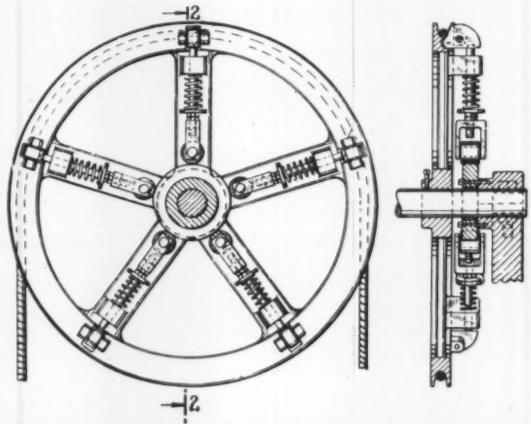
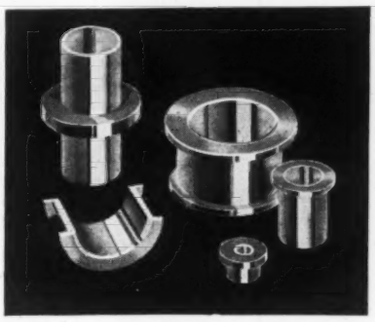


Fig. 2—Automatic gripping jaws actuated by central cam give positive drive to round belt

Sleeve BEARING DATA

FLANGED
Sleeve-type Bearings



THERE are many and various reasons for using a flange in sleeve bearing applications. Principal among these is where end thrust is a factor in the operating conditions. However, a flange can also serve to locate or anchor the bearing, to act as a hub or a divider and to form a recess as an aid to lubrication.

Where end thrust is the prime reason for the flange, we must determine the load to be carried. This in turn will dictate the size and thickness of the projection. In cast bronze bearings, it is possible to locate the flange anywhere on the outside diameter. This feature aids considerably in cases where we wish the flange to serve as a divider, hub, or anchor and at the same time must comply with certain limits in our design. In electric motor bearings the flange often has a beveled edge to insure alignment. In some applications it is often difficult or impossible to locate the oil intake in the proper place to insure good lubrication and at the same time make it convenient or accessible. In such cases a small flange will create a recess between the bearing and the housing. The oil intake on the housing can then be located in the most convenient place, while the corresponding hole in the bearing located where the operating conditions demand. The recess will also serve as a convenient storage for excess lubricant.

LAMINATED

Internal combustion engines favor laminated flange-type bearings for their applications. As with all laminated bearings, the dual construction enables the user to combine the best qualities of two separate and distinct bearing materials into one bearing. In some cases the babbitt, or other lining material, is used on both the flange and the inside diameter. In cast bronze bearings, the flange is included on the casting. With steel backed bearings, the steel shell is formed before the babbitt is added.

SELF-LUBRICATED

In applications where the operating speed is comparatively slow, it is often wise to use graphite impregnated bearings. The graphite can be included not only in the inside diameter but on any of the three faces of the flange. As a further aid to lubrication it is possible to include oil grooves on the flange. Experience has proven that a double eccentric groove on the outside flange usually serves best in feeding oil to the bearing surface.

Check . . . these points when ordering Flanged Bearings

It is important that ALL dimensions are clearly given when securing flanged bearings. As a guide, use this diagram to check the various points.

FULL HALF or SAW CUT. Saw Cut bearings can be used where shims are also included. FULL HALF bearings are more expensive but are necessary for precision fits.

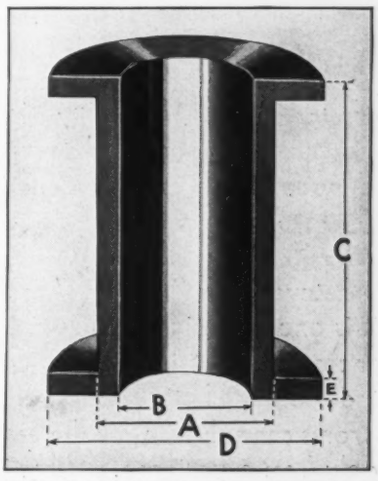
A — Outside diameter of bearing.

B — Inside diameter of bearing.

C — Length — over all of bearing.

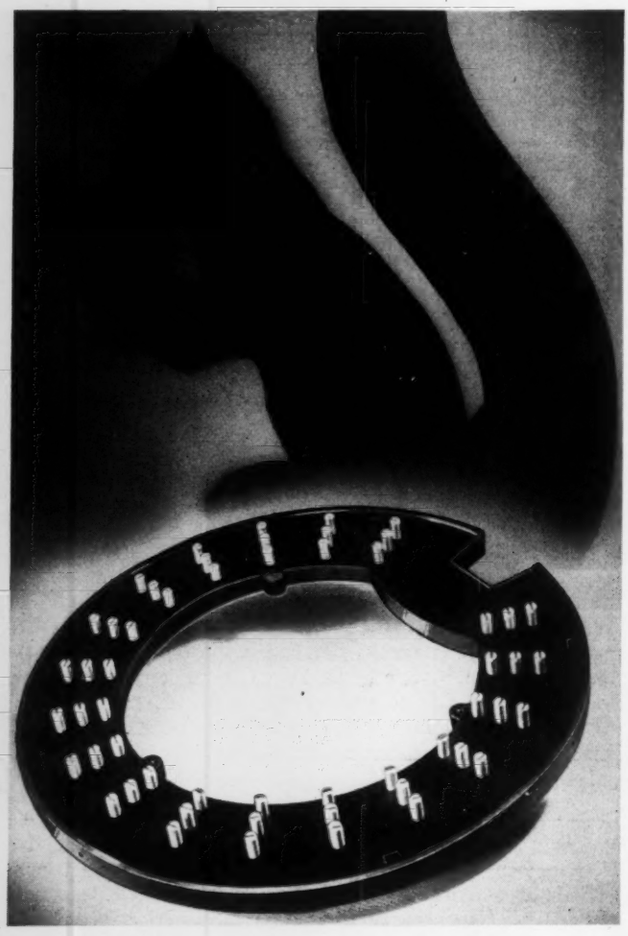
D — Outside diameter of flange.

E — Thickness of flange.



Engineers—This is but one of a series of Fundamental facts concerning sleeve-type bearings. Write for the complete series.

JOHNSON BRONZE COMPANY
525 SOUTH MILL STREET • NEW CASTLE, PA.
Sleeve BEARING HEADQUARTERS



A HARD NUT *to Crack*

Sixty years' experience doing the impossible—pioneering in producing molded plastics of greater beauty and utility—have earned for the Auburn Button Works a reputation second to none, for accomplishment in the face of difficulties.

Whatever your "hard nut" problem, whether it is one of design, of unusually close tolerances or of obtaining on-schedule deliveries, the Molded Plastic Division of Auburn Button Works can solve it with the ease which comes only from experience. What is more, they'll do it better and more economically.

Established 1876

MOLDED PLASTICS DIVISION OF
AUBURN BUTTON WORKS, Inc.
AUBURN, N.Y.

the pulley in such a way that when their outer arms are lifted by the push rods, their inner faces squeeze down upon the belt in its groove, which they enter through narrow openings.

In operation the cam is set so that its lobe or high point is toward the center of the arc of contact on the pulley. As the pulley turns the grippers begin to close at the point where the belt normally enters the pulley, and they retain their grip until the belt is about to leave the groove. The mechanism is reversible, operating equally well in either direction.

Bearing Has Helical Channel

WITH the end in view of providing a special purpose combined radial and thrust bearing of unusually high load capacity for its size, and having even distribution of load, Walter R. Griswold of Detroit has developed the design depicted in *Fig.* 3. This is covered by patent No. 2,076,180 which has been assigned to Packard Motor Car Co.

The assembly consists of two telescopically arranged members which are spaced apart by balls. The inner or shaft element has "ears" projecting at each end and the outer sleeve or housing is fastened to the main frame of an automobile. The unit shown is designed specifically as a mounting for the link mechanism connecting a front steering wheel of an automobile with the main frame to permit vertical movement thereof relative to the frame.

Shaft and housing have helical grooves which coincide as a channel when the unit is assembled.

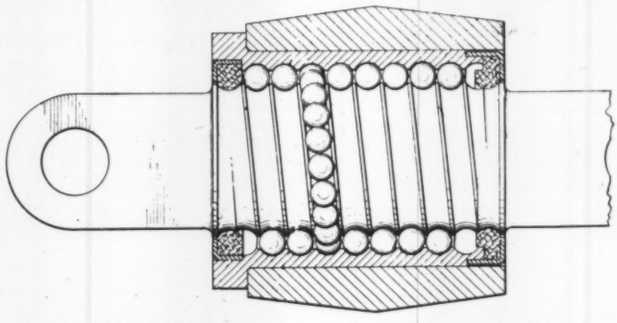


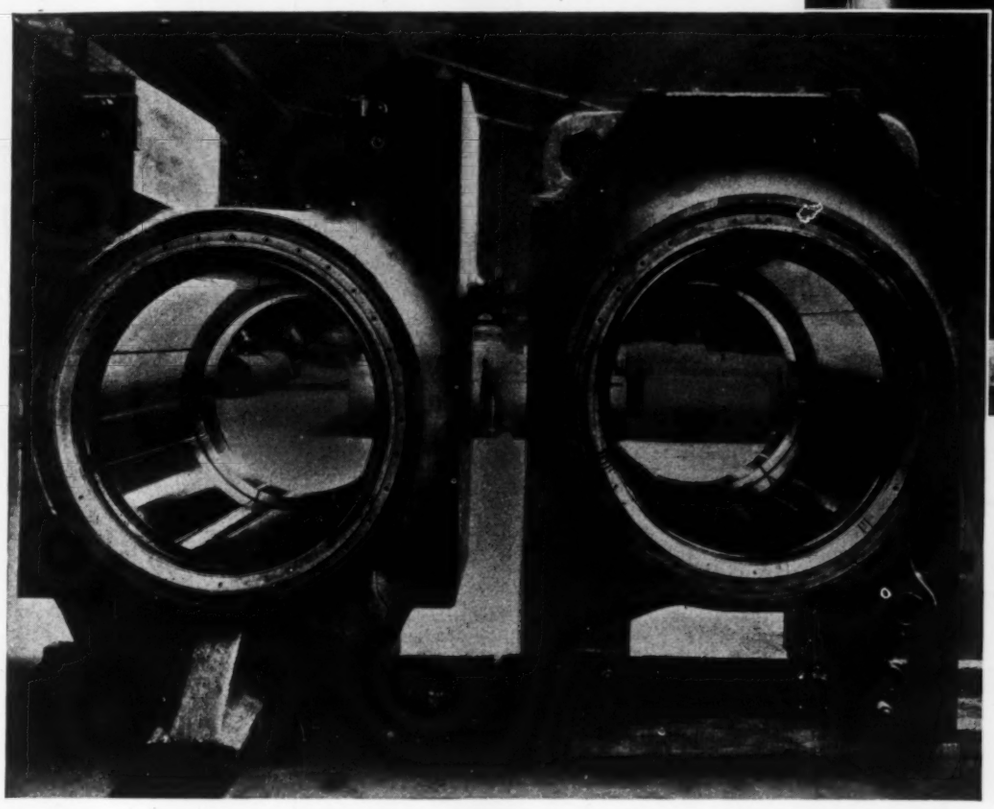
Fig. 3—*Helical bearing has large capacity, with even distribution of thrust and radial loads*

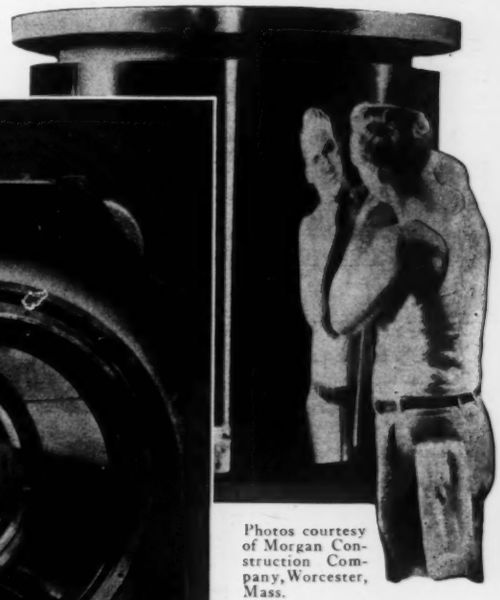
Balls are placed therein to the full capacity of the helical channel — these being retained by felt rings in circular recesses at each end. The inner shaft serves as a pivot and has a limited oscillating movement in its adjacent sleeve. Due to the helical channel containing the balls, thrust load is taken substantially over the entire length of the bearing structure and radial load is taken at practically any point along the bearing which is normal to the axis. Distribution of thrust load is said to be uniformly and radial load is taken by an unusually large number of balls, one important result being high durability.

5,247,000 lb. load

CARRIED BY

U·S·S CARILLOY ALLOY STEEL





Photos courtesy of Morgan Construction Company, Worcester, Mass.

(Above) *Its perfect mirror finish is especially remarkable in view of the fact that it is only ground — not polished. This accurate finish truly reflects the quality of the steel.*

(At Left) *Here it is — the world's largest capacity roll-neck bearing — designed to carry a radial load of 5,247,000 lb.—and made of USS Carilloy Alloy Steel as specified. In view of the investment involved it would obviously be poor economy to select any but the finest available alloy steel.*

IN the photograph above you see another record-breaker . . . the largest capacity rollneck bearing in the world.

This bearing is made of a grade of USS Carilloy Alloy Steel—one of the family of high quality alloy steels made and sold by Carnegie-Illinois. This steel was specified by the design engineers who are responsible for its performance.

It is a flood-lubricated sleeve-type bearing of the 56″-90 series—part of a new 3-stand tandem rolling mill—designed to carry a radial bearing load of 5,247,000 lb.

To make a bearing of this size and capacity economically feasible, to insure long life, minimum wear, and smooth accurate surfaces . . . it is obvious that the maker would not fail to select the finest, the most dependable alloy steel available.

In recent advertisements, you have read of the precision quality of USS Carilloy Alloy Steels and the delicate control under which they are made . . . how, to insure maximum quality and utmost uniformity, we have concentrated on alloy steel production in special alloy plants.

This application is interesting evidence from an unbiased source . . . evidence that USS Carilloy Alloy Steels are, in fact, the finest alloys it is now possible to make.

U·S·S CARILLOY ALLOY STEELS

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh *Chicago*

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

United States Steel Products Company, New York, *Export Distributors*

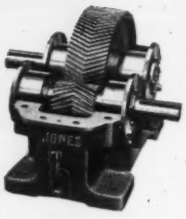
UNITED STATES STEEL

SINGLE! DOUBLE! TRIPLE!

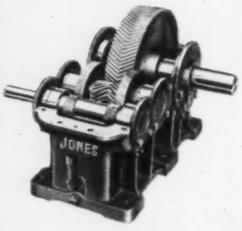
—every type of Herringbone Speed Reducer that you might need

JONES Herringbone Gear Speed Reducers are built in a wide range of ratios and ratings to cover every requirement. Single (Type SH) reducers in standard ratios range from 1.25 to 1 up to 11 to 1 in ratings from 1.3 to 440 H.P. Double (Type DH) reducers are built in standard ratios from 10.9 to 1 up to 72 to 1 in ratings from 0.5 to 275 H.P. The triple reduction reducers (Type TH) cover a range of ratios from 86.9 to 1 up to 355.8 to 1 in ratings from 0.3 to 78 H.P.

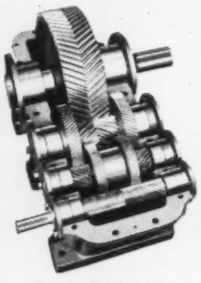
All these reducers have heat treated gears, ground shafts and are mounted with anti-friction bearings throughout. Cast iron bases are available for all variations of motor assembly. Liberal stocks are carried to facilitate shipments.



Single Reduction Type SH



Double Reduction Type DH



Triple Reduction Type TH

W. A. JONES FOUNDRY & MACHINE CO.

4413 Roosevelt Rd., Chicago, Ill.

HERE'S THE LATEST INFORMATION

about the application of Herringbone Reducers

This new 96-page catalog of Jones Herringbone Reducers presents a vast amount of data relating to Herringbone Reduction Units. Illustrations show a broad range of herringbone reducer applications and the technical information shows how to select reducers for all conditions of service in accordance with the A.G.M.A. recommended practice.

Write for your free copy of this valuable treatise

Since 1890

Jones

HERRINGBONE -- WORM — SPUR — GEAR SPEED REDUCERS

CUT AND MOLDED TOOTH GEARS — V-BELT SHEAVES

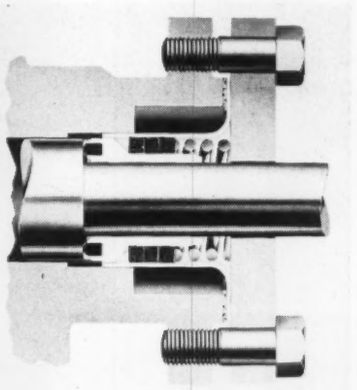
ANTI-FRICTION PILLOW BLOCKS — PULLEYS

FRICTION CLUTCHES AND TRANSMISSION APPLIANCES

NEW *Materials and Parts*

Long Life, Feature of Shaft Seal

DESIGNED for the elimination of leakage of gases and liquids around rotating or oscillating shafts of compressors and pumps, a shaft seal of unusual construction has been developed by Syntron Co., Homer City, Pa. The main sealing and wearing surface of the new seal is an antifriction and self-lubricating compound inserted in bearing metal of the finest quality. Sealing head of the bearing metal



Compressed packing rings that grip seal head close to bearing face eliminate chattering and assure quietness of operation

with its antifriction insert is held firmly against the shoulder on the rotating shaft by a strong spring which also expands the packing rings, sealing the bearing head to the housing. Major advantages of this seal are said to be the entire elimination of leakage over a long period without adjustment, self-sealing action, self-lubrication and self-centering. The unit is supplied with gasket, ready for installation.

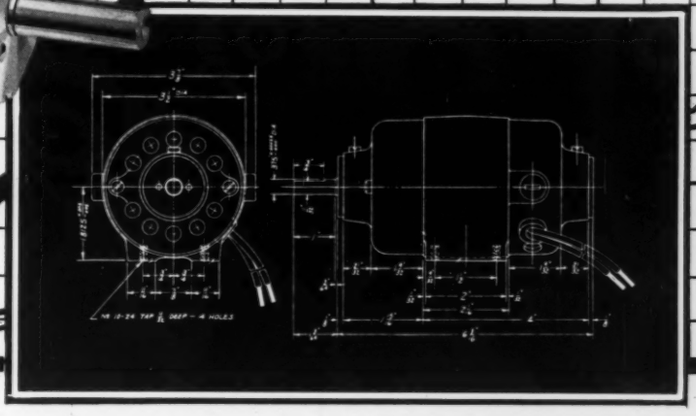
Air Cylinder Made for Severe Duty

SPECIALLY adapted to heavy duty operations, an extra-heavy type air cylinder has been placed on the market by Hannifin Manufacturing Co., 621 South Kolmar avenue, Chicago. The new "LO" series air cylinders are honed to produce a mirror finish bore that is concentric to within .001 inch. Flanges of the "LO" type cylinders are screwed to the barrel and then welded to produce a unit which will withstand long, severe use. The cylinders are being made in a full range of standard sizes up to 16 inches bore

A DUMORE MOTOR DELIVERS MORE

Power Hours

TYPE KB MOTOR



SPECIFICATIONS
TYPE KB MOTOR

Class of Motor	Plain Series (Univ.), 0-60 Cycles	
Construction Details—		
Degree of Enclosure	Open	
Method of Cooling	Internal Fan	
Bearings and Lubrication	Grease-Packed Ball	
Housing Material	Cast Aluminum	
Weight	4 lb. 12 oz.	
Rating (Full Load, Continuous Duty)—	A. C. Operation	D. C. Operation
Volts	115	115
Amperes	2.7	2.3
Watts Input	290	300
Horsepower Output	1/5	1/4
Torque (Lb.-Ft.)	.157	.190
Full-Load R.P.M.	7,000	6,500
No-Load R.P.M.	14,500	13,500
Efficiency	53%	59%
Duty	Continuous	Continuous
Temperature Rise	40°C.	40°C.

APPLICATIONS

- Routers
- Drills
- Grinders
- Blowers
- Buffing machines
- Therapeutical pumps
- Boring machines
- Vacuum cleaners

POSSIBLE MODIFICATIONS

- Other than 115-volt winding
- C.C.W. or reversible rotation
- Other than standard rating
- Shunt winding for d. c. service
- Special shaft extension
- Other than standard housing finish

★ In Dumore motors you get a smoother flow of power, day after day, *years longer.* A wide variety of stock motors insures economy and prompt delivery, but when these motors do not conform to your specifications, you get one designed and built by Dumore engineers for your particular job. The recommendations of these experienced men, plus Dumore precision manufacturing methods, assure you *more power hours* for your money.

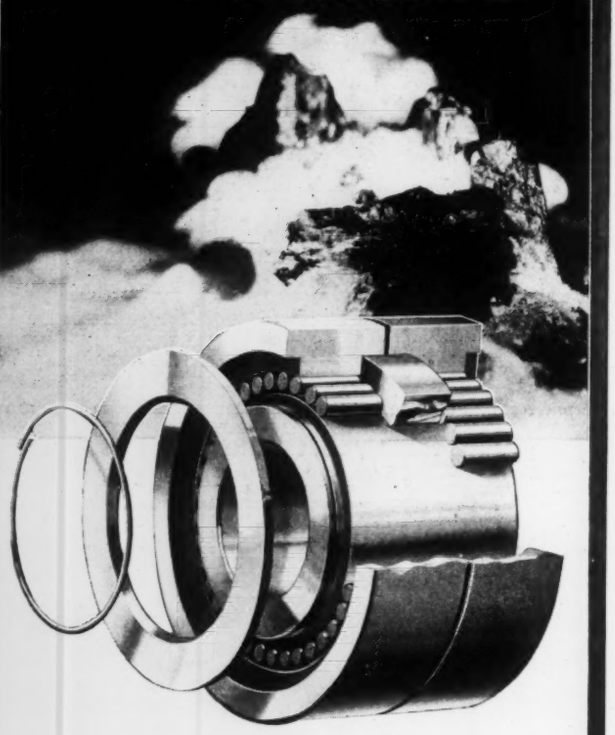
Dumore builds series universal motors (AC—DC) from 1/600 h. p. to $\frac{3}{4}$ h. p.—0 to 60 cycles. They are selected for powering hundreds of machines . . . heavy shop tools to fine jeweler's lathes . . . are relied upon to operate retractable landing gear of aircraft and delicate controls of telescopes.

Let Dumore engineers show you how to get *more power hours* for *your* product. Write for catalog and engineering service application blank.

THE DUMORE CO., DEPT. 127J, RACINE, WIS.

DUMORE
FRACTIONAL HORSEPOWER
MOTORS

. . . Ceaseless



McGILL
MULTIROL
Precision Needle Bearings

Like the rugged coasts that take the pounding of the sea, McGILL MULTIROL Bearings stand up under the incessant pounding of sustained heavy or intermittent shock loads.

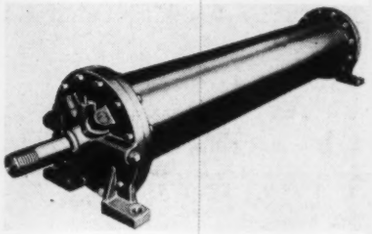
For great load capacity in small radial space, nothing equals McGILL MULTIROL Bearings.

Made in many designs for practically every type of equipment. Stocked in sizes from ⅝" to 6" bore, single and double rows of rollers, at low, volume production prices. Corrosion and heat resisting types and special designs to order.

Send for the MULTIROL Bulletin

McGILL MANUFACTURING CO.
Bearing Division, 1450 N. Lafayette St.
VALPARAISO, IND.

and for air pressures up to 250 pounds per square inch. Perfect piston fit in these honed cylinder bores



Flanges of air cylinder are screwed to barrel and then welded, making a trouble-free unit

gives lasting efficiency and economical use of air in any installation.

Air Filter Washed in Oil

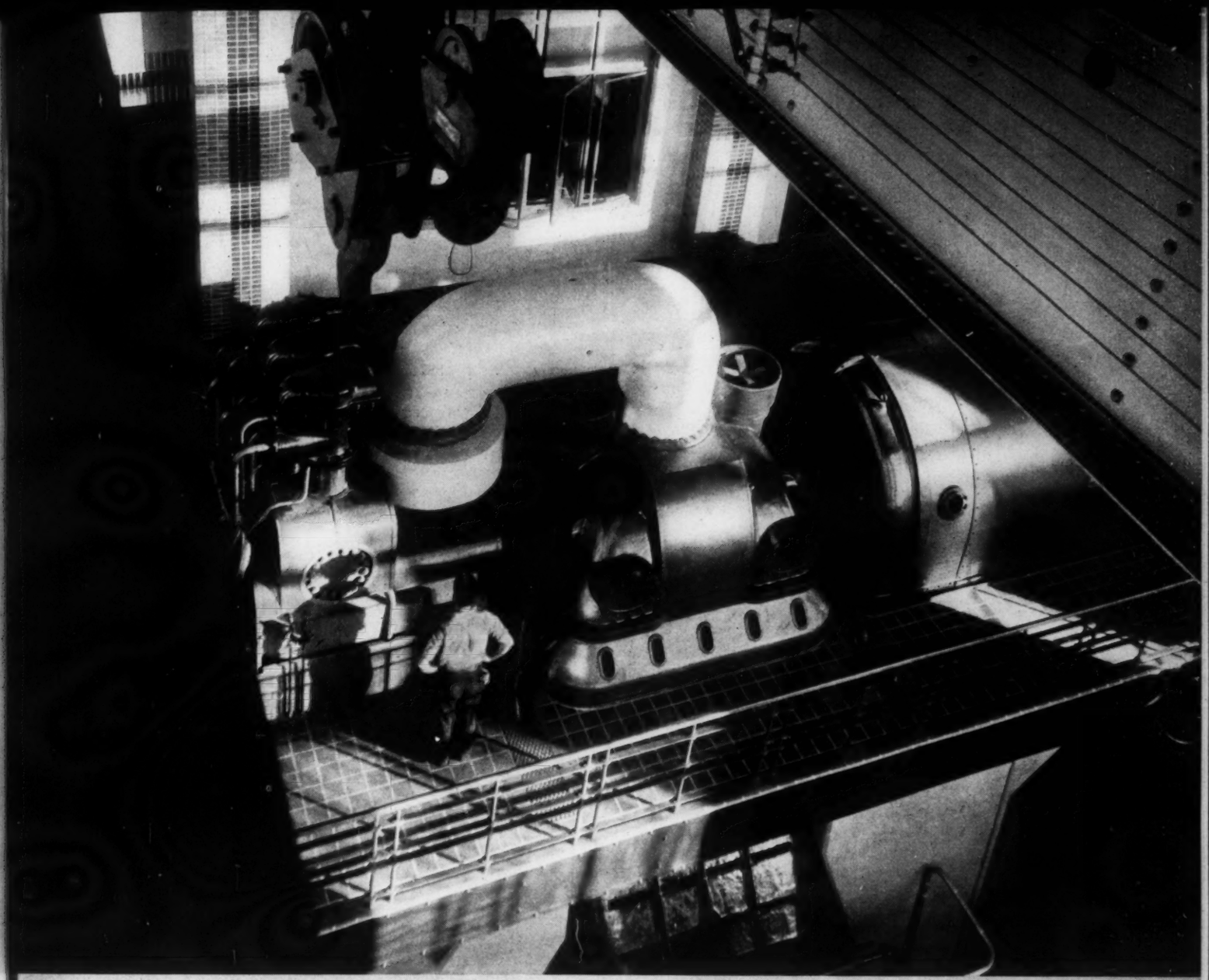
OIL-BATH air filters, produced primarily for truck and power plant installations, have been brought out by Donaldson Company, Inc., St. Paul, Minn. Features of the new filters include self-washing screen element, backfire arrestor, violent oil action at idling speeds, ability to handle chaff and similar

Oil filter occupies little space, but has high dust-collecting efficiency

matter without clogging and a quiet zone in oil reservoir to permit dust to settle. Available in a number of sizes, the filters may be applied to almost any type of engine, compressor or machine in which dust elimination is important.

Variable Speed Unit Improved

AN IMPROVED design of the Vari-speed motor pulley, countershaft type, has been developed by Reeves Pulley Co., Columbus, Ind. It is a simple, compact variable speed unit which is mounted on the standard shaft extension of any constant speed motor. For requirements of either unusual speed reduction or speed increase, a countershaft is mounted on a common base with the rest of the unit. In the earlier design, the pulley on the countershaft from which power take-off was made to the driven machine, was mounted on the end of the shaft. In the new design this pulley may be mounted in the center



POWER NEEDS PROTECTION

GENERATORS, great sources of electrical energy, would work in vain without adequate insulation. *Synthane* plays its part. *Synthane* protects—protects the flow of energy from generator to bus bar to substation to point of use. . . . *Synthane* has many other applications. . . . *Synthane* Bakelite-laminated is a uniformly dense, solid material possessing a combination of useful physical, chemical, mechanical and electrical characteristics. It is tough, strong and light in weight; one of the most effective dielectric materials; chemically inert and corrosion resistant. It is easy to machine. The uses for *Synthane* are countless. . . . *Synthane* is a type of material indispensable in insulating electrical products. It may similarly be of material assistance in the manufacture of your product. Write for "*Synthane* for Mechanical Applications". (Please indicate your requirements in your request)... *Synthane* gives you *Material Satisfaction.*

SYNTHANE CORPORATION, NORTH RIVER RD., OAKS, PENNSYLVANIA

SHEETS • RODS • TUBES • FABRICATED PARTS • SILENT STABILIZED GEAR MATERIAL

SYNTHANE

Bakelite— laminated

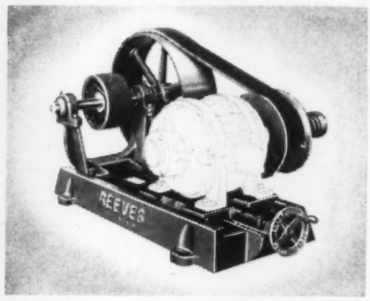
MOTORS

of Special Design

TEXTILE loom motors; splash-proof motors for dairies and wet places; vertical motors—these are only a few of the special designs Peerless has available. Peerless builds special motors for grinders, pumps and equipment of all kinds. Range of sizes ¼ to 10 horsepower Send us your drawings and specifications.

THE Peerless ELECTRIC CO.
WARREN, OHIO

of the countershaft, between the two bearing housings, thus providing a more compact, space-saving unit. Although a straight-face pulley is illustrated, power take-off may also be from sprocket, pinion, multiple V-belt, sheave or other accepted drive. The variable speed pulley unit is built in seven sizes, transmitting from fractional to 7½ horsepower, and covering speed ratios of 3:1.



New design of unit allows pulley to be mounted in center of countershaft, thus making more compact unit

Rheostat Has Nonbreakable Frame

FOR use in field circuits of motors or generators where the maximum field current is not more than ten amperes, a heavy duty rheostat with non-embedded grid type resistors has been placed on the market by The Clark Controller Co., Cleveland. Features of the rheostat include a nonbreakable, ventilated supporting frame; noncorrosive resistor grids; monson slate base; large shaft and bearing, and copper or monel metal button contacts. Calibrated indicating dial with 50 speeds points permits precise variation.

Calibrated indicating dial allows precise speed variation

Pump Handles Corrosive Liquids

ENGINEERED to handle corrosive liquids, a single suction, centrifugal pump has recently been introduced by Lawrence Pump and Engine Co., Lawrence, Mass. In this unit, known as the type SC Vortex pump, materials such as stainless steel, nickel,

FELTERS FELT

for industrial efficiency

HAVE you overlooked one of the most useful and versatile materials for greater efficiency and economy in your plant? Felt has taken gigantic strides in the industrial field during the past few years. Engineers and superintendents are today looking over their buildings, equipment and products with an eye to obtaining the widest benefits that felt can furnish. Check on these points:

REDUCTION OF VIBRATION
HEAT INSULATION
GREASE RETENTION
MACHINE HOUSINGS
INSTRUMENT MOUNTING
MACHINERY PACKING
SOUND ABSORPTION
WEATHERPROOFING
LUBRICATING WICKS
DUFELT (NEOPRENE) WASHERS
SHOCK ABSORBERS
INSULATING WASHERS

Over a wide range of industry, the practical skill and experience of Felters Engineering Department has given practical aid in furnishing forms and qualities of felt to fit each problem. Your inquiries will receive interested cooperation.

THE FELTERS COMPANY, Inc.

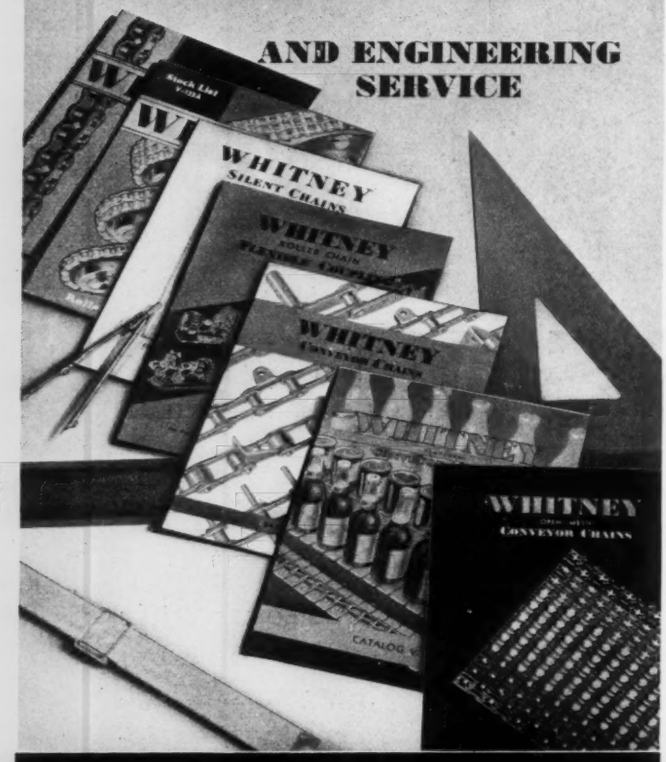
Manufacturers of Felt and Felt Products

210 SOUTH STREET **Dept. MD** **BOSTON, MASS.**

SALES OFFICES IN PRINCIPAL CITIES

WHITNEY CHAINS

AND ENGINEERING SERVICE



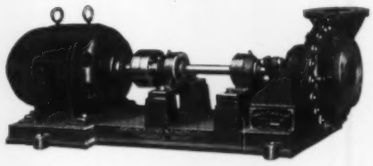
Whitney Chain Drives for Power Transmission and Conveying purposes offer an unusually wide latitude of design to the engineer and manufacturer of industrial machinery. They can be designed for

- High average ultimate strength
- Overload capacity—Long Life
- High, medium or low speed drives
- Smoothness and quietness of operation
- Short or long shaft centers
- Flexibility for unusual space requirements
- Reversibility of shaft operation
- Practically any desired chain attachment
- Pressure rollers for carrying load
- Corrosion and heat resistance
- Patented no back bend feature
- Patented automatic drive release

Let Whitney Chains and engineers cooperate on your problems. Write today for Catalog A. The Whitney Chain & Mfg. Co., Hartford, Conn.

WHITNEY CHAINS

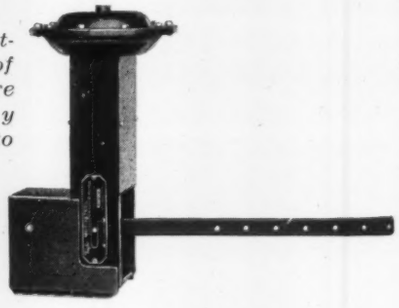
monel metal, bronze, lead or aluminum are used depending upon the particular application. Ball bearing construction, deep stuffing boxes, and a vertical split casing which makes all parts readily accessible, are features of the pump. For evaporator and similar service a stuffing box with an outside type of pot seal is available. When completely filled with liquid, this seal shuts out all air and is said to be an invaluable feature when operating under a high vacuum.



Stainless steel and other corrosion-resistant metals are used in this pump

Air-Driven Lever Motor Offered

CONSTRUCTED to overcome the nonuniform operating characteristics of pneumatically powered lever motors, a new type has been developed by Taylor Instrument Cos., Rochester, N. Y. Design and operating features of the new motor recommend it for the operation of dampers, lever operated valves, electrical rheostats for variable speed motors, or for the movement of any device by the conversion of pneumatic energy to linear or angular mechanical motion. The motor is of all-steel welded construction and base is drilled for mounting. A deeper diaphragm with larger area than earlier models gives greater power and smoothly modulated action. The lever is pivoted in phosphor-bronze bushings. Three sizes are now being manufactured which in terms of maximum damper areas that may be controlled are 25, 50 or 120 square feet.



Lever motor is suitable for movement of any device where pneumatic energy must be changed to mechanical motion

Magnetic Valve Resists Corrosion

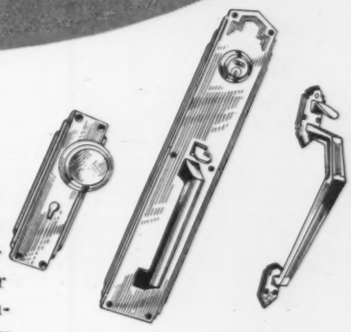
DESIGNED for liquid and suction line control of freon, methyl chloride and sulphur dioxide in air conditioning and refrigerating equipment, model

ECONOMICAL

...because they pay

EXTRA DIVIDENDS

in service

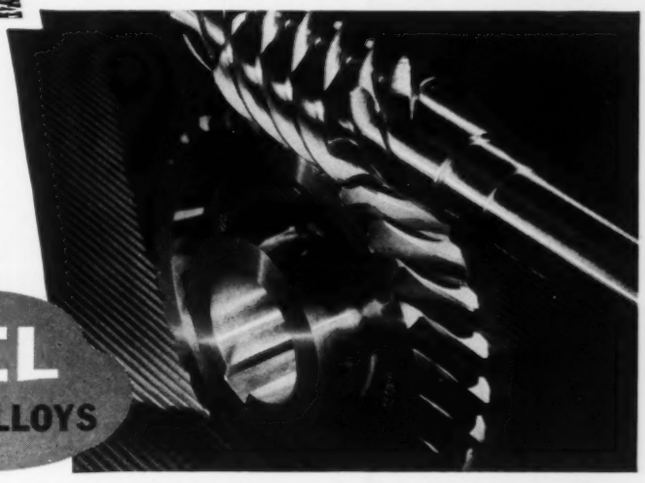


A LASTING purchase is thrifty! With solid white bronze—Nickel Silver—fittings, time is turned aside and thrifty buyers reap their reward. Continuous finger traffic, the weather and general wear and tear soon change the appearance of hardware whose beauty is only skin deep. But Nickel Silver resists the rub of fingers and cleaning, the corrosive action of the weather, and the stresses of day to day service. Solid, with no coating to chip or peel, the Nickel Silvers are tough. durable, wear resisting and always beautiful. Their use continually pays dividends in satisfactory lifetime service.

• ° •

A STEAM condenser is a unit of thrift to conserve boiler water and make it work again and again. Corrosion, erosion, high pressures and temperatures are the constant enemies of condenser life and maintenance. Therefore, many of the world's leading navies and commercial fleets, shore stations and oil refineries are increasingly using thrifty Cupro-Nickel tubes in their condensers to increase reliability and cut down overhaul and maintenance expenses.

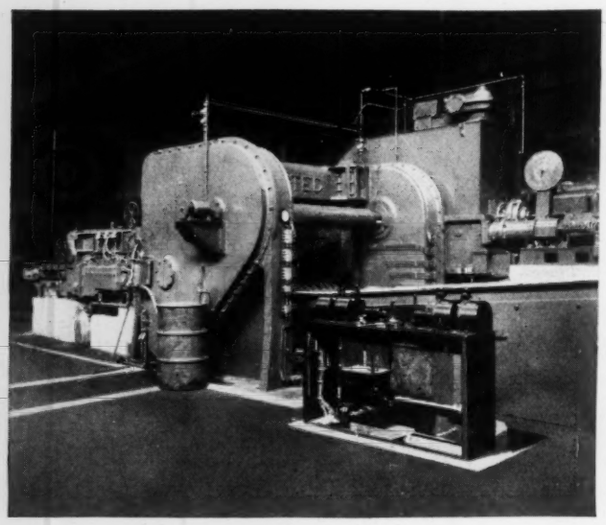
THE best materials are thrifty! This worm gear drive with Nickel-Bronze gear and Nickel Steel worm is an excellent example. Eight of these drives were installed 15 years ago on chewing gum mixing machines demanding steady nine-hour per day service under heavy intermittent load with accompanying stresses. Caution prompted a supply of spares for emergency replacement—but they are still in storage, for after 15 years the original drives continue to prove their real worth and low, final cost. We invite consultation on the use of the alloys of Nickel in your equipment.



NICKEL

NON-FERROUS ALLOYS

THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.



When you

CAN HEAR BEARINGS

IT IS TOO LATE!

• When a starved bearing *"groans"* and runs a high temperature, shut-downs and lost production invariably follow.

Outage time for bearing repair is rarely due to the kind of oil used, but more often because at some time, some of the bearings don't get any.

A Farval Centralized System of Lubrication will insure positive delivery of lubricant to all bearings at all times and will protect your production against the delay and expense of bearing repair or replacement. In addition, Farval will lower consumption of power; reduce consumption of lubricant; eliminate the labor of oiling and prolong the life of your equipment.

The Farval System is a mechanical method of delivering clean lubricant from a central station under high pressure to a group of bearings, in exact, measured quantities. Operation is constant and positive, regardless of the number of bearings in the system, *and not a bearing is missed.*

Farval Engineers will gladly help you plan the System best adapted to the production equipment you design and build. The Farval Corporation, 3265 East 80th St., Cleveland, Ohio.

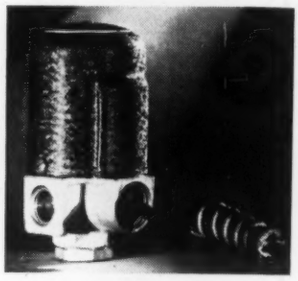
Affiliate of The Cleveland Worm & Gear Company, Cleveland, Manufacturers of Automotive and Industrial Worm Gearing.

FARVAL

CENTRALIZED SYSTEM OF LUBRICATION

Special Delivery to Every Bearing

73-RB solenoid valve has been announced by Automatic Products Co., 2450 North 32nd street, Milwaukee, Wis. The valve incorporates such fetures as a brass forged body, stainless steel valve stem, special alloy valve seat, and a nonmagnetic tube and stem.

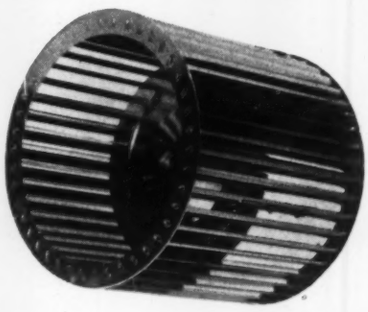


Seat and needle assembly may be removed for inspection without taking valve from line

By removing the bottom plug the seat may be unscrewed, and both the seat and needle assembly drop out for inspection and cleaning. Power consumption is approximately 15 watts and the valves operate at lifting pressures of 125 to 150 pounds. The entire line is designed for ⅜-inch pipe connections.

Pressure Raised By Blower Wheel

HIGHER static pressures are possible with the new "slip-lock" blower wheel introduced by Viking Air Conditioning Corp., Cleveland. Unique type of construction insures that both ends of every blade in the wheel are locked in simultaneously. Particular care has been taken in manufacture to insure



Noise is reduced and higher static pressures are possible with this blower wheel

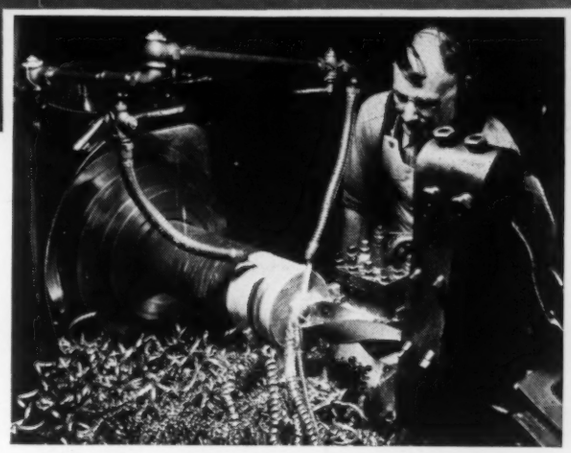
that the wheel is perfectly balanced. Four sizes of the new blower wheel are available ranging in capacity from 1100 to 3200 cubic feet of air per minute.

Magnetic Plug Attracts Metal Chips

METALLIC chips which collect in the oil pans of internal combustion engines, differential housing and transmissions may be collected and held at one point by a magnetic oil drain plug introduced by Lisle Corp., P. O. Box 1260, Clarinda, Iowa. The plug may be used with any mechanical equipment where it is desired to keep metallic foreign matter

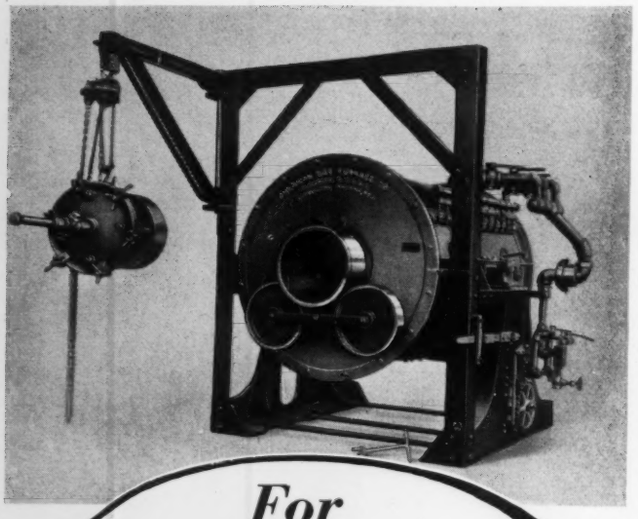
• Moving acres of earth, rolling tons of steel, drilling deeper oil wells, harvesting grain, transporting materials and building them into finished products, or just out for a drive —the chances are that Hyatt Roller Bearings are there, so broad is the range of Hyatt bearing sizes and applications in industrial equipment, farm machinery, and motor cars.

Turning wheels, shafts, and gears in every service, owe their power and maintenance conservation to Hyatt Roller Bearing design, precision, and strength. Masters of bearing manufacture and application, Hyatt engineers and craftsmen are competent to meet all your requirements. Hyatt Bearings Division, General Motors Corporation, P. O. Box 476, Newark, New Jersey.



Machine tool manufacturers like **WARNER and SWASEY,** whose Turret Lathe is illustrated, have found that Hyatt Roller Bearings are setting a new standard of accuracy for anti-friction bearing use. It will pay you to specify Hyatts by name on all machine tool orders.

HYATT
ROLLER BEARINGS

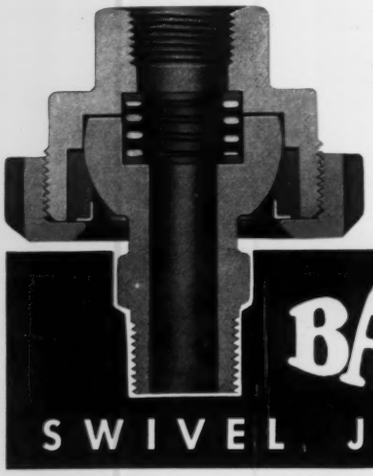


For
UNINTERRUPTED PRODUCTION

● BARCO Swivel Joints are preferred equipment for every type of production machinery requiring pipe movements. A typical production-accelerating application is shown above. To assure uninterrupted output by this rotary retort tilting type Carburizing Machine, leak-proof swing in pipe lines is entrusted to BARCO.

To guard against the time and money losses that result from faulty pipe movement or frequent shut-downs for repairs, specify and use BARCO Swivel Joints. They provide full 360° swivel movement without binding . . . are so constructed that gaskets will not blow out . . . are steam, gas and fluid-tight under rapid and extreme temperature changes . . . and are equally leak-proof under suction or pressure.

BARCO MANUFACTURING COMPANY
1820 Winnemac Avenue Chicago, Illinois



● Catalog 256, giving complete descriptions of BARCO Swivel Joints and their wide range of application, will be mailed on request.

BARCO
SWIVEL JOINTS

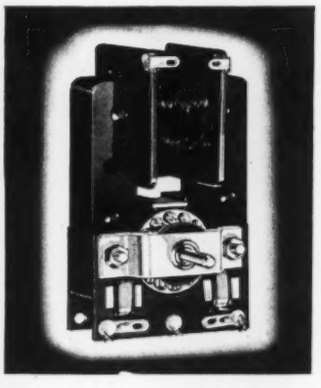
out of a lubricating system. It is available in sizes to fit any drain opening. A powerful permanent magnet which holds its magnetic properties indefinitely is in the core of the unit.

Powerful permanent magnet in core of drain plug collects metallic shavings

Small Reversible Motors Offered

MINIATURE, reversible motors built to answer the most exacting requirements of engineers have been announced by Alliance Mfg. Co., Alliance, O. Reversal is easily accomplished by a simple control switch in a low power circuit. Trouble-free operation is assured by use of perfectly straight shafts, ground to tolerances of .00025-inch. The shaft runs in graphite-bronze bearings surrounded by a large oil reservoir.

Shaft on small motor runs in graphite-bronze bearings surrounded by oil reservoir



Automotive Finish Has Initial Gloss

A FINISH known as Automotive "Pyralux" which dries with the speed of "Duco" and has a high initial gloss that requires no rubbing is announced by E. I. du Pont de Nemours & Co., Wilmington, Del. Its chalking resistance is comparable to that of a baked enamel, thus making it a satisfactory finish for painting machines or for touching up cars. Automotive "Pyralux" is a straight nitrocellulose product especially developed to meet a specific need by combining the features of lacquer and synthetic enamels. It is so designed that it possesses fairly high initial gloss, with good build and flow out, and dries quickly.

(*Continued on Page* 82)

Everlock * DUAL ACTION

Caught by the Camera

U. S. Pat. No. 1775705

Only Everlock Washers have this patented dual-acting tongue.

Unretouched

Note sharp edges in contact with surfaces—tongues set for flexing when nut is tightened.

Sharp edges embedded, forming positive lock. Tongues flexed — setting up powerful Spring Tension.

Unretouched

Released — tongues back to original position—definite evidence of powerful spring action.

Unretouched

Only Everlock Washers make these long, deep indentures — definite evidence of locking so positive that only a powerful wrench can release the nut.

Unretouched

* POSITIVE LOCKING AND POWERFUL SPRING TENSION

To keep screws and nuts tight requires two definite principles:

(1) Powerful Spring Tension set up by the flexing of many tongues.

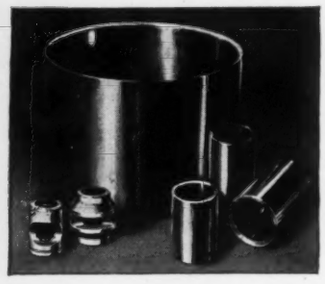
(2) Positive Locking by sharp projecting edges on tongues that dig into the working surfaces.

These pictures show how Everlock Washers afford this dual action — show why you can depend on Everlocks to reduce complaints and service calls wherever nuts or screws are used.

FREE SAMPLES mailed on request. Just specify sizes you want.

Thompson-Bremer & Co.
1640-G W. Hubbard St. CHICAGO

Everlock DUAL ACTION LOCK WASHERS



YOU DON'T have to be a wizard to produce instantly one or one million bronze bearings at any time—in any or all of hundreds of different sizes—completely machined and finished, ready for assembly—meeting practically every requirement in all kinds of machinery and electric motors. Simply select what you want from Bunting's Catalog of Standardized Bearings. Your order is filled the day we receive it . . . Economical, too — small lots even at big-run prices.

Bunting Machined and Centered Bearing Bronze Bars are just as readily available in 131 stock sizes. Factory machining saves you time, labor, material. . . . And try Bunting Lead Base and Tin Base Babbitt to see how scientifically controlled casting improves a standard alloy. Ask your mill supply wholesaler. Complete catalog on request. . . . The Bunting Brass & Bronze Co., Toledo, Ohio. Branches and Warehouses in in All Principal Cities.

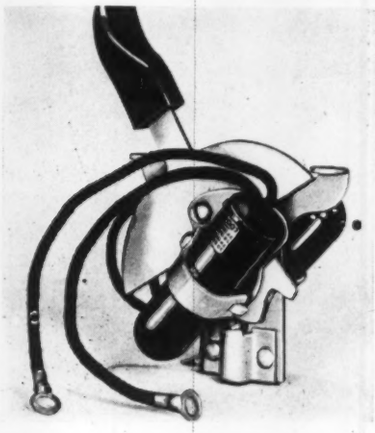
BUNTING Bunting **Quality**
BRONZE BUSHINGS • BEARINGS
MACHINED AND CENTERED BRONZE BARS
BABBITT METALS

(*Continued from Page 76*)

It may be used on all types of general refinishing of metal. This new finish is offered in black and 26 popular shades.

Mercury Switch Offered

REMOTE control of electrical circuits is simplified by a recent development of Jefferson Electric Co., Bellwood, Ill., which provides a universal control switch mechanism. Designed for mounting to the rear of a panel with only the switch handle protruding, it serves to give finger tip control over

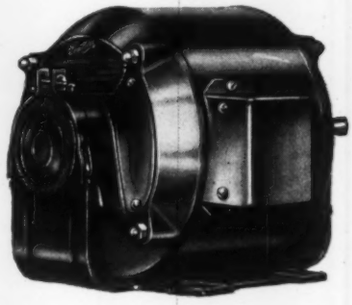


Nonbreakable metal mercury tubes are clamped securely to switch but may be easily removed

motor circuit contactors, safety and limit switches. One or more nonbreakable metal mercury tubes are clamped in screw-down clips, selectively yet permanently positioned. Each tube will make and break a circuit of 15 amperes and 125-volt alternating current rating without arcing. Two switch movements are available: Off-on and center-return. An adjustable sector permits mounting to a vertical, horizontal or angular positioned panel.

Many Motor Types in New Line

COMPLETE new line of fractional horsepower motors in sizes from 1/6 to ¾-horsepower is



Motors are designed with interchangeable mountings for a wide variety of machine operations

announced by The Century Electric Co., St. Louis, Mo. The motors are available in repulsion start induction, single phase, split phase, capacitor, polyphase

HANNIFIN "LO" SERIES HEAVY DUTY AIR CYLINDERS

HAVE MIRROR-FINISH BORE for Perfect Piston Fit

Honed bore of a 16 in. x 7 ft. cylinder

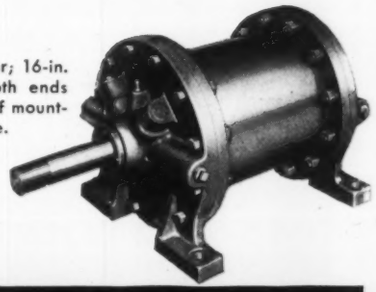
This new series of extra heavy air cylinders offers strong, simple construction suited to any type of heavy duty application, plus the high-efficiency performance delivered by new precision manufacturing methods.

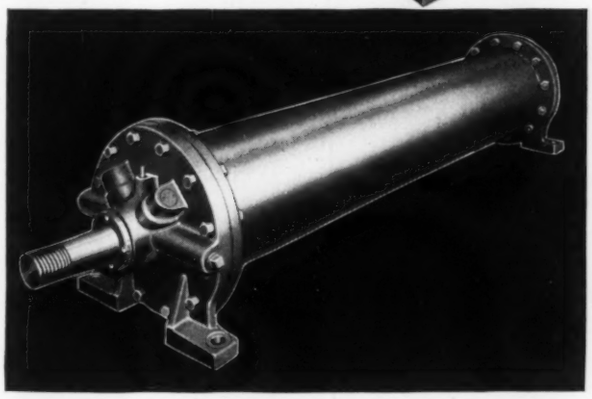
"LO" series cylinder bores are honed to a mirror-finish on special long-stroke honing machines developed by Hannifin engineers. The bores are straight, round and concentric within a tolerance of .001 in. Perfect piston fit in a honed cylinder bore means sustained high efficiency and most economical utilization of air power.

Cylinder flanges are screwed on; then welded to the cylinder body. Heads are cast steel, with or without air cushion at either or both ends. A variety of standard mountings are available to suit individual requirements.

Available in a full range of standard sizes up to 16-in. bore, for any length stroke, and air pressures up to 250 lbs. Special sizes built to order. Hannifin engineers will submit recommendations on receipt of your specifications.

"Heavy-Duty" air cylinder; 16-in. bore, 17½-in. stroke, both ends cushioned. Other types of mountings are available.





"Heavy-Duty" air cylinder; 16-in. bore, 7-ft. stroke, both ends cushioned

HANNIFIN MANUFACTURING COMPANY

621-631 South Kolmar Avenue, Chicago, Illinois

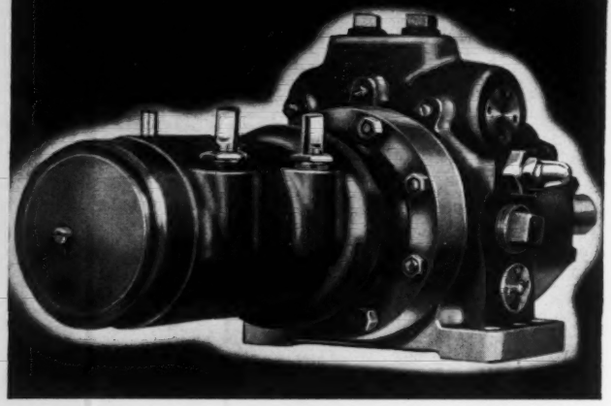
Engineers • Designers • Manufacturers

Pneumatic and Hydraulic Production Tool Equipment

HANNIFIN "Heavy-Duty" AIR CYLINDERS

INTRODUCING

TWO NEW Sundstrand PUMPING UNITS



For Economical Automatic Actuation of Machine Members and Elements

Two new Sundstrand Pumping Units, the 5PWX and 10PWX, are now available for reliable, accurate hydraulic rapid traverse and feed movements of machine members and elements. The Units comprise a constant volume pump for rapid traverse, a variable displacement piston pump for two independently adjustable feed rates, and main control valves all built into a small, compact housing which is readily incorporated in machine designs. The 10PWX Unit can have *three independent feed rates;* an exclusive Sundstrand feature which provides means for maintaining maximum production despite changes in character of work-pieces or machining operations.

The automatic movement of machine members provided by these Units, including the shifting from one pre-set feed rate to another, can be controlled by Sundstrand hydraulic or electrical remote controls operated by dogs on the moving members. The feeds are exceptionally smooth; the feed rates infinitely adjustable within the capacity of the Unit. The Units run at motor speed of 1200 r.p.m.

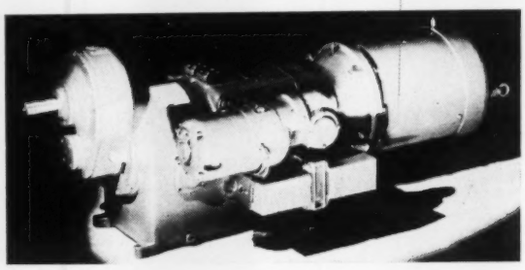
Sundstrand PWX Pumping Units are the products of many years experience in designing and manufacturing pumping units, hydraulic circuits, valves and remote controls. They are reliable, powerful, efficient, durable; simplify machine design, improve operation, and reduce machine cost. The services of our engineering department are available to executives interested in developing applications of Sundstrand Hydraulic Equipment. Write, today, for complete information.

SUNDSTRAND MACHINE TOOL CO., *Pump Division*
2550 Eleventh St., Rockford, Illinois
PUMPING UNITS • FLUID MOTORS • CONTROLS

and direct current types. They are designed with interchangeable mountings for a wide variety of machine applications. Fundamental principles of the new line are the same as have been used by Century for many years, but many improvements have been added.

Hydraulic Transmission Is Compact

SINGLE transmission unit combines 7½ horsepower driving motor, reduction gears, hydraulic variable speed transmission and small geared-head motor with built-in brake for controlling variable speed. Built by The Oilgear Co., Milwaukee, Wis., this unit permits remote control and finds wide application where a



Reduction gears, driving motor, variable speed transmission and speed control motor are built as one unit

compact motorized variable speed transmission is required. Known as type DEC-88, the transmission has a normal output rating of 8½ horsepower and a peak rating of 12 1/3 horsepower when operating at a maximum speed of 1090 RPM. The output end of transmission is equipped with a 3.52:1 helical gear reducer which reduces maximum speed to 300 RPM.

Rectifier and Transformer in One

"RECTIFORMER," a unit combining a 110-volt alternating current transformer and a copper-oxide rectifier, used primarily to provide a six-volt direct current power supply for power relay operation, has been placed on the market by Weston Electrical Instrument Corp., Newark, N. J. Output of the transformer is 120 milliamps continuous, or 200 milliamps intermittent. Features of the unit include: (1) Resistor in output circuit protects sensitive relays from "kick back" voltage. (2) Unit is designed specifically for uses in which six-volt circuit is opened and closed, rather than the 110-volt alternating current circuit. (3) Voltage and current ratings are such as to assure satisfactory relay operations at all times. (4) Wiring is arranged to eliminate the possibility of improper connections which might damage relays. Known as model 9980, the rectiformer may be used for any direct-current requirement where filtered current is essential.

FAMED JEWELED CROWN OF OUR LADY OF THE ANDES *Fashioned as a thanks offering to the Virgin Mary by the grateful inhabitants of Popayan when that city escaped a dreadful plague in the early 16th Century. Made of pure gold, set with 453 emeralds, the largest of which weighs 45 carats, the crown is valued at $4,500,000 and is considered one of the finest creations of the hand of man through the ages.*

Only for the Few

To create anything so fine that its craftsmanship transcends all comparison is almost entirely a matter of ideals. Hoover Ball and Roller Bearings are created to achieve mechanical perfection . . . quality rather than quantity. It is obvious that such a purpose means that they cannot be constructed cheap enough for ordinary use. But, by this very token they are a mark of distinction for the machines they serve.

☆ *The Aristocrat Of Bearings*

HOOVER

Ball and Bearing Company

ANN ARBOR · MICHIGAN

TEN impressive words from the letter of a customer whose large plant is isolated by miles and days from sources of replacement parts—and whose equipment is so generally operated by Cleveland Worm Gear Drives that the failure of even a single unit might have tied up the whole plant.

But *didn't!* His "Clevelands" had been installed 8 years previously and still showed no effects of wear when he wrote the above.

Studying the performance records of thousands of other Cleveland Worm Gear Speed Reducers installed 10, 15 or more years ago in a wide range of industries reveals that this type of report is rather usual, not at all exceptional.

To install Cleveland Worm Gear Speed Reducers in the machine equipment you design and build is to assure quiet but reliable delivery of power for almost indefinite years to come; and to enhance your customers' satisfaction.

Ask nearby District Representative for newest data on "Clevelands"—the worm gear speed reducers that serve indefinitely with "not a moment of delay—not a penny of cost."

The Cleveland Worm & Gear Company, 3275 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR *Speed Reducers*

MEETINGS *and* EXPOSITIONS

Sept. 11-19—

National Printing and Allied Industries Exposition. To be held at Chicago Coliseum. Additional information may be received from headquarters at 82 Washington street, Suite 812, Chicago.

Sept. 14-17—

British Iron and Steel institute. Autumn meeting in Middlesbrough, England. K. Headlam-Morley, 28 Victoria street, London, S. W. 1, is secretary.

Sept. 19-23—

International Management congress. Seventh congress, to be held in Washington, D. C. with Lord Leverhulme of Great Britain as president. Additional information may be obtained from the headquarters at 347 Madison avenue, Room 1201 New York.

Sept. 20-22—

American Gear Manufacturers association. Twentieth semiannual meeting to be held at Spink-Wawasee hotel, Lake Wawasee, Ind. J. C. McQuiston, Penn Lincoln hotel, Wilkinsburg, Pa., is manager-secretary.

Sept. 28-Oct. 1—

Association of Iron and Steel Engineers. Thirty-third convention and exposition to be held at Hotel Stevens, Chicago. Brent Wiley, 1010 Empire building, Pittsburgh, is managing director.

Sept. 29-Oct. 1—

Society of Automotive Engineers. Fuels and lubricants national regional meeting to be held at the Mayo hotel, Tulsa, Okla. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

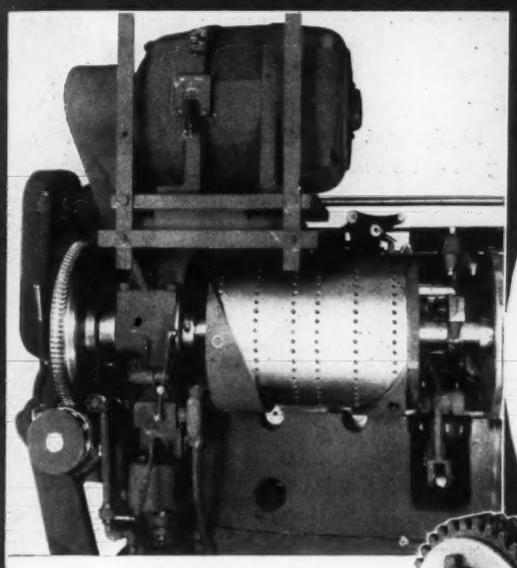
Sept. 30-Oct. 1—

American Foundrymen's association. Mid-year meeting to be held at Columbus, O. D. M. Avey, 222 West Adams street, Chicago, is secretary-treasurer.

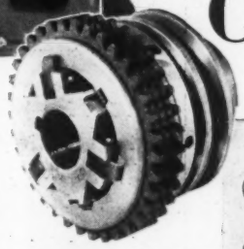
Oct. 4-9—

Chicago Exposition of Power and Mechanical Engineer-

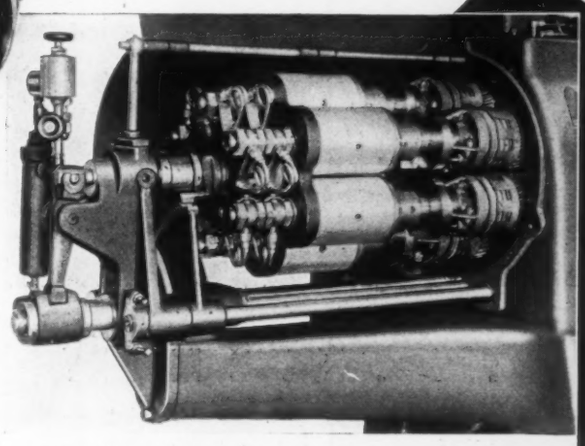
Fast, flexible operation built-in with TWIN DISC CLUTCHES



Feed Brake of Cleveland *Model K Multiple Spindle Machine, showing Twin Disc Clutch directly under the worm wheel at the extreme left end of the machine. Another Twin Disc, in the feed drive, engages the high speed and working speed motion.*



Twin Disc Single Close Coupled Dry Type Clutch



Twin Disc Clutch assembly in the stop spindle of Cleveland chucking *machines. Clutch is automatically disengaged in the upper front or loading position and automatically engaged again as the spindle turret indexes.*

● **Present-day production economies depend upon fast, flexible operation—and it must be built-in with the controls.**

The Cleveland Automatic Machine Co., Cleveland, Ohio, find that Twin Disc Close Coupled Multiple Disc Clutches have improved the operation and increased the efficiency of *Cleveland* Automatic Chucking, Boring and Screw Machines. They chose Twin Disc particularly because of its simplicity of adjustment and sturdy construction. And, being more easily installed, it has simplified their design.

All parts in these close coupled model clutches are accurately machined and carefully finished to be suitable for use on the highest grade machine tools. Contacting friction surfaces are of hard phosphor bronze and tempered saw steel. Operating parts are heat treated to obtain maximum strength and hardened surfaces, thus insuring continued service with a minimum of maintenance. Made in 2½ in. to 12 in. sizes, in either single or duplex construction, oil or dry type. All sizes have positive locking, single point adjustment. Plates may be adjusted as little as .003—an important feature, since it provides maximum capacity with lowest operating pressures.

Write today for specific recommendations. Engineering data on request.

TWIN DISC CLUTCHES

TWIN DISC CLUTCH COMPANY
1325 Racine Street
RACINE • WISCONSIN

. . . . . **SAVE MONEY**

Dowmetal reduces your operating cost, increases your pay load capacity in transportation, and lowers freight charges on your product.

. . . . **SAVE MACHINES**

Wellman castings of Dowmetal give longer life to machines because their weight, one-third lighter than aluminum, reduces vibration and wear of moving parts.

. . . . . **SAVE MEN**

Wellman-made Dowmetal castings, light in weight, reduce fatigue of workers.

Bent Tubes • Machined Parts
Plated Parts • Castings

EASTERN REPRESENTATIVE: THE ELLCON CO., 50 Church St., N. Y. City

The WELLMAN
Bronze and Aluminum Co.
5900 SUPERIOR AVENUE
CLEVELAND OHIO

ing. To be held at International Amphitheatre, Chicago. Charles F. Roth, Grand Central Palace, New York, is manager.

Oct. 6-7—

Farm Equipment institute. Forty-fourth annual meeting to be held at Palmer House, Chicago. R. A. Jones, 608 South Dearborn street, is secretary.

Oct. 7-9—

Society of Automotive Engineers. National aircraft production meeting to be held at Ambassador hotel, Los Angeles, Calif. John A. C. Warner, 29 West Thirty-ninth St., New York, is secretary.

Oct. 11-13—

National Printing Equipment association. Annual meeting to be held at Statler hotel, Cleveland. James E. Bennet, 38 Park Row, New York, is secretary.

Oct. 11-15—

National Safety council. Twenty-sixth national safety congress to be held at Muehlebach hotel, Kansas City, Mo. W. H. Cameron, 20 North Wacker drive, Chicago, is managing director.

Oct. 12-13—

Porcelain Enamel institute. Seventh annual meeting to be held at Congress hotel, Chicago. George P. MacKnight, 612 North Michigan avenue, Chicago, is managing director.

Oct. 18-22—

American Welding society. Eighteenth annual meeting and welding exposition to be held respectively at Hotel Traymore and Convention hall, Atlantic City, N. J. M. M. Kelly, 33 West Thirty-ninth street, New York, is secretary.

Oct. 18-22—

American Institute of Mining and Metallurgical Engineers. Meetings of the Institute of Metals and Iron and Steel divisions to be held at Atlantic City, N. J. Louis Jordan, 29 West Thirty-ninth street, New York, is assistant secretary.

Oct. 18-22—

Wire association. Annual meeting to be held at Ambassador hotel, Atlantic City, N. J. Major Richard E. Brown, 17 East Forty-second street, New York, is secretary.

Oct. 18-22—

National Metal congress. Nineteenth annual national metal show to be held in Atlantic City auditorium, Atlantic City, N. J. Additional information may be obtained from W. H. Eisenman, managing director, American Society for Metals, 7016 Euclid avenue, Cleveland.

A reproduction of Model AC4, 4 Cyl. Air-cooled engine

•

Single and 4 Cyl. models. 1 to 16 H.P.

. . . NO GREASE CUPS OR OIL FITTINGS ON THESE ENGINES

The only requirement — gas in the tank and oil in the crankcase. The engines will do the rest.

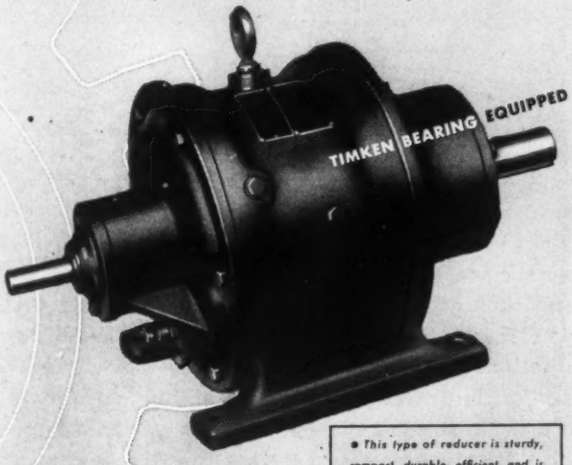
Write for specifications.

HEAVY DUTY AIR COOLED ENGINES by WISCONSIN MOTOR CORPORATION

WISCONSIN
MOTOR CORP., MILWAUKEE, WIS.

SPUR GEAR REDUCERS

(PLANETARY DRIVE TYPE)



• *This type of reducer is sturdy, compact, durable, efficient, and is equipped with Timken Roller Bearings*

The D. O. James Planetary Spur Gear Reducer is superior to any other type, having a gear arrangement that produces the highest possible gear ratio.

D. O. JAMES MANUFACTURING CO., 1120 W. MONROE ST., CHICAGO

D.O.JAMES

FOR ALMOST FIFTY YEARS MAKERS OF EVERY TYPE OF SPEED REDUCER AND CUT GEAR

The part that looks like a toy bugle really isn't. It's a coil for a well known refrigeration system.

The strangest coils and shapes eventually come to Wolverine's fabrication department. Here is the experience in handling tube of all kinds that has solved many a manufacturer's production problems. Helps keep the costs down.

The applications of All-In-One Finned Tubing, another specialty of Wolverine, are too numerous to list. The fins are integral with the tube, permitting easy coiling or forming.

Straight lengths, fabricated parts, bends, coils of copper, brass, aluminum. Ask Wolverine for a prompt quotation from sample, blue print or sketch. No obligation.

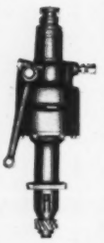
WOLVERINE TUBE CO.

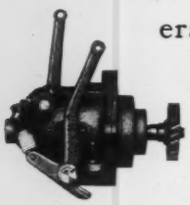
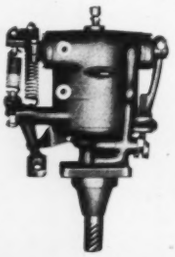
1475 Central Ave., Detroit, Mich.

POWER CONTROL
perfected by
PIERCE

•

Through twenty-five years of engineering experience and governor research, the Pierce Governor Company has developed a line of governors that completely covers every industrial application. • *The Pierce Engineering Staff* co-operates with engine designers and builders, and all manufacturers of engine-driven equipment in the development of new or unusual types of governors to meet today's needs. • Correct in principle, painstakingly built to a minimum tolerance, Pierce Governors are recognized as standard the world over. • Put your governor problems up to Pierce—write for new complete catalog just off the press.



PIERCE GOVERNOR COMPANY
109 OHIO AVE., ANDERSON, INDIANA

PIERCE GOVERNORS
STANDARD SINCE 1913

Location of Noise Source Is Scientific Study

(*Continued from Page* 46)

bearings, and in the motor there will be electromagnetic noise. With the conventional non-synchronously driven fan, the noise frequency analysis will show up those components which are multiples of motor speed and those components which are multiples of the supply frequency so that the electromagnetic sources can be separated from the mechanical sources.

It will be readily seen that a problem such as a fan requires study of the several component parts. In the first place, the analyses of existing fans indicated that the predominant noise source originated in the fan blades. These were first studied from the standpoint of air flow and substantial results were immediately achieved by the use of stroboscopes, smoke, high-speed cameras and some mathematical analyses. As a result of this work, a new type of blade was developed which accelerated the air with a great deal less turbulence than any blade developed up to that time. When operated as a fan with belt drive, the noise produced for a given air flow was certainly gratifying to those engaged in the development. But when this blade was coupled with its proper motor it was found that the overall noise reduction was not so satisfactory. This required analyses of the motor itself and substantial progress was then made in reducing the motor noise. This involved study of electromagnetic as well as purely mechanical noise sources.

Fan Blade Amplifies Vibrations

After all this was done, the complete fan was still found to be somewhat noisy, although when freely suspended by itself, the motor proved very quiet. It was then found that the blade design resonated with some otherwise small vibrations of the motor causing the blades to act as a sounding board to make these vibrations a substantial portion of the total noise produced. This, of course, immediately pointed the way to a modified blade design and this particular problem was attacked with a feeling that the final source of noise had been tracked down and was well on the way toward complete elimination. The fan blade changes did produce considerable results but still the fan was not as good as had been expected. It was then found that the base of the motor with its inverted horn shape proved a good resonator for approximately the same sound frequencies to which the blades had resonated previously. Upon correction of this problem, the complete fan did meet expectations. This does not mean that the fans were absolutely

SPRING WASHERS

Spring washers and lock washers of every type and size, including the well-known Hipower and Kantlink types. There are thousands of more places where spring washers would improve the value of any product where bolts, nuts, cap or machine screws are used.

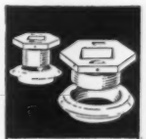
STEEL ROD ENDS

Drop forgings including steel rod ends of the adjustable yoke, plain yoke, and eye types. These articles in standard sizes and threads afford tremendous savings over special designs.

RETAINING RINGS

Spring retaining rings of special heat-treated spring steel are carried in many stock sizes—both open and closed types. Use of a spring retaining ring is an excellent manner of creating a shoulder on a shaft.

STEEL BARREL CLOSURES



Forged and machined fittings for steel barrels, drums, tanks and metal packages, including plugs, rings and flanges. Very rugged for use in transportation of alcohol, turpentine, oils and other expensive liquids.

CONTAINER HANDLES

Forged steel handles for heavy containers—can be rigidly welded, riveted or attached by a strap to lie flat when not in use. Rugged and most satisfactory for hard usage.

RHEOSTATS—RESISTORS—LOAD BOXES AND SPECIAL APPARATUS

Our electrical division—Hardwick, Hindle, Inc.—makes as fine electrical resistance products, fixed and variable, as can be devised.

• • • • • •

Other products include windows for buses and railway cars, railway car window curtains, curtain rollers and fixtures, sash locks and lifts.

THE NATIONAL LOCK WASHER COMPANY

NEWARK, N. J. — EXPORT DIV., 15 E. 26 St., N. Y. C.

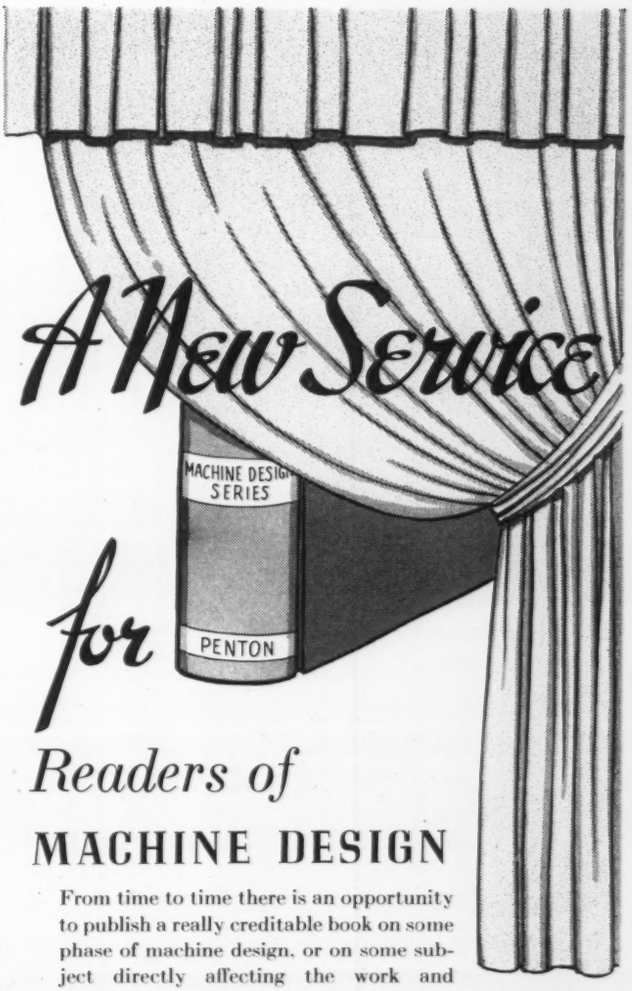
cam slide

Where ACCURACY of adjustment is so essential, leading machinery builders are utilizing LAMINUM shims as standard equipment. Precision adjustments . . . by simply p-e-e-l-i-n-g paper-thin brass laminations from the LAMINUM shim! Machining, grinding and fitting in factory assembly are saved . . . and the same saving is repeated for your users every time service adjustments are required.

LAMINATED SHIM CO., INC., 21-26 44th Ave., Long Island City, N. Y.
Cleveland Detroit Milwaukee

694

LAMINUM
Precision adjustment **SHIMS**



Readers of

MACHINE DESIGN

From time to time there is an opportunity to publish a really creditable book on some phase of machine design, or on some subject directly affecting the work and functions of the machine designer. In order that readers of MACHINE DESIGN may benefit by these treatises, MACHINE DESIGN announces the first book of its series, to be published this fall.

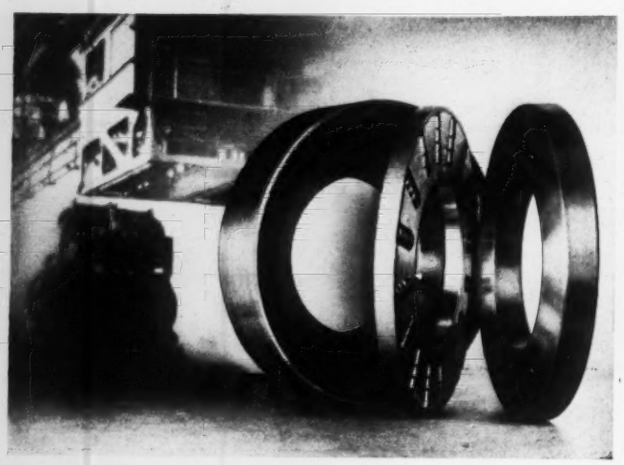
"INVENTIONS AND THEIR PROTECTION"

By George V. Woodling, B. S., L.L.B., E.E.

Directly affecting every development in engineering design, patents and patent law are all-important in securing adequate protection. Mr. Woodling, an outstanding patent attorney and himself the owner of numerous patents in the automotive and air conditioning fields, has prepared an exhaustive manuscript dealing with problems of "Inventions and Their Protection." Written in non-legal terminology, and profusely illustrated with drawings and photographs, this book should have a prominent place on every executive engineer's and designer's desk for ready reference. For complete contents, publishing date and price, see forthcoming issues of MACHINE DESIGN.

MACHINE DESIGN

Cleveland



PROTECTED against dirt and moisture

A common materials handling bearing application was giving continuous trouble because of severe impact loads and overloads. It was necessary to work out a substitute bearing of much greater capacity, which would be wholly interchangeable, and protected in some degree from dirt and moisture. The lubricant, though adequate in quantity, was apt to be dirty.

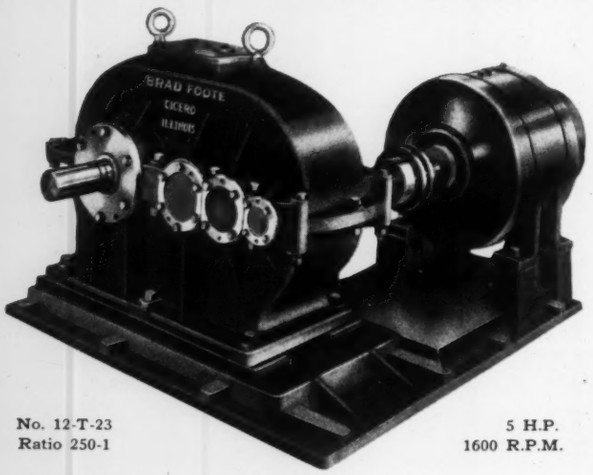
ROLLWAY not only worked out the necessary bearing, a pure thrust bearing, using the principle of loads perpendicular to roller surface, but developed a line covering all standard application sizes. The result has been a very real saving to users throughout the country.

A ROLLWAY Analysis of your bearing problems aims at maximum performance, which only concentrated experience and study in a single field can give.

Note: This is one of the first occasions when any sort of seal was built integral with the bearing. Though fully exposed, not one of these bearings has ever failed through corrosion.

ROLLWAY BEARING CO. INC., SYRACUSE, N. Y.

Brad Foote's Reducer for Tube Mill Service



No. 12-T-23 5 H.P.
Ratio 250-1 1600 R.P.M.

This triple herringbone reduction unit—just installed to drive a tube mill—where dependable constant heavy duty service are requisite—embodies the ideas gained by years of experience in the manufacture of gears and gear reduction units and in the solving of problems in the transmission of power.

Wherever Brad Foote speed reducers are installed—and their number is many—in plants generally throughout the country—they may be found giving this same satisfaction. There is a type for every need—and a competent engineering staff to advise you.

A new easy to use Speed Reducer manual is now ready—ratings may be had at a glance—new ideas on power transmission—will be definitely helpful—send for your copy.

FOOTE GEAR WORKS, INC.
1301-G. S. Cicero Ave. Cicero, Illinois

quiet, but it did mean that a very substantial improvement was made and since this initial work additional improvements have been made. As time goes on a few changes will undoubtedly be made here and there which, while they may not represent a great alteration in basic principle, may be very ingenious in themselves and in the long run will lead to quieter fans.

Assembly of Parts Must Be Studied

In general, this is true of a great many household appliances in which the noise problem is of prime importance. The household mechanical refrigerator has been studied on the same basis as the electric fan. Here again, great progress has been made by first reducing the vibrations produced by each component part and then studying the assembly of these parts carefully with a view toward not amplifying the otherwise small vibrations present in these parts.

Such noise work is going on in a great number of fields and in a large number of different devices. It is especially important that equipments for use in residences and offices be very quiet. With the advent of air-conditioning, a great deal of attention has been given to study of noise produced by air flow in ducts and through grille work. In connection with elevators and air-conditioning equipment, attention has been directed toward eliminating communication of noise from this service equipment to the building structure.

Click Noises Difficult to Eliminate

A further important source of noise upon which much work yet remains to be done is in noise produced by the discontinuous motion of mechanical parts. This includes the click noise produced by business machines, such as typewriters and various computing equipment and electrical devices such as relays and contactors. The problem in such devices is difficult because of the parts whose motions are suddenly interrupted by the action of the device.

In all these cases, however, the solutions come by virtue of the four factors forming the base of our design information today, and which have formed the outline of this paper: First, a good quantitative understanding of sound level; second, a good understanding of simple vibrating systems; third, a good measurement technique; and fourth, experience in producing definite results on existing equipment. It is worth repeating, also, that these four basic factors will broaden as experience increases and from this broader foundation will evolve the more quiet machines customers demand.

Bibliography

1. Measuring Vibration Velocity by Charles D. Greentree, General Electric Review, September, 1937.
2. Quiet Machinery Often Costs Less by Ernest J. Abbott, MACHINE DESIGN, December, 1936.
3. Nature of Noise Influences, Type of Corrective by P. H. Geiger, MACHINE DESIGN, July 1932.
4. Effective Noise Reduction Depends upon Basic Knowledge by P. H. Geiger, MACHINE DESIGN, July 1932.
5. Noise and Machines—Must They Be Synonymous by Hiram Percy Maxim, MACHINE DESIGN, June 1932.

K&E LEROY
REG. U. S. PAT. OFF.
LETTERING SETS

for

BETTER LETTERING!

Here is a formula for better lettering: Select a template from your Leroy set...follow the engraved characters with a pressureless stroke of the scriber...and the pen forms perfect lettering, directly in ink, exactly where you want it. No guide lines, no "roughing in". Vertical and slanting letters can be made from the same template. You'll want the advantages of a Leroy set. Ask your K&E dealer, or write for the new booklet.

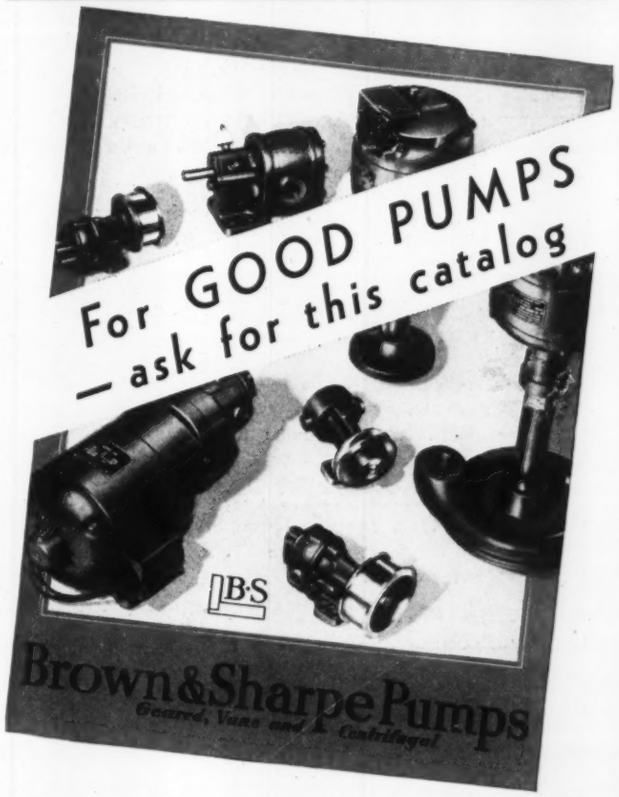
EST 1867 **KEUFFEL & ESSER CO.**
HOBOKEN, N. J.
NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO DETROIT MONTREAL

HEDMAN
Check Protectors

Are Powered by
BODINE MOTORS

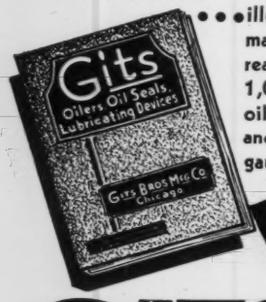
Motors that drive business appliances must be reliable under conditions of frequent starting. They must also be very compact. The Hedman Mfg. Co. have found both of these features in the Bodine universal series motor. They have standardized on these Bodine speed reducer motors for their line of check protectors and mechanical check signers.

Bodine motors are built to the highest standards. They are reliable, compact, smooth-running, and attractive in appearance. In addition, Bodine engineers have specialized in the adaption of these motors and the development of special motors to fit the exact requirements of each machine. Let them help with your drive problems. Write Bodine Electric Co., 2258 W. Ohio St., Chicago, Ill.



Write—Brown & Sharpe Mfg. Co.
Providence, R. I.

BODINE
BODINE
FRACTIONAL H. P.
MOTORS
ENGINEERED FOR YOUR PRODUCT

Announcing
OUR NEW GENERAL CATALOG
Your copy of the new GITS lubricating equipment catalog,
• • • illustrating and describing many new features, is now ready for mailing. Over 1,000 styles and sizes of oil cups, including oil and grease seals, oil cans, gauges, etc. are shown.


oil cups
oil and grease seals
oil cans
gauges
GITS BROS
MANUFACTURING CO.
1861 S. KILBOURN AVE., CHICAGO

Smooth Performers
For smooth, dependable performance, machine tool builders specify Roper Coolant Pumps. These pumps throw a heavy stream, free from pulsation, with sufficient force to reach the deepest cuts and bores. Guaranteed not to lose prime, they work against high or low pressures. Sturdy, simple construction (only 2 working parts) gives long life and high efficiency. Write for Bulletin R4MD.

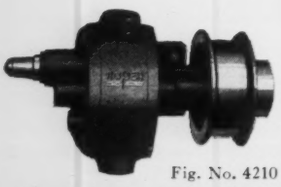



Fig. No. 4210
ROPER
Coolant
PUMPS
GEO. D. ROPER CORP., ROCKFORD, ILL.

MANUFACTURERS' PUBLICATIONS

ALLOYS (NICKEL) — Story of the use of alloyed cast irons in petroleum equipment is told in section 1, number 6, of Nickel Cast Iron Data issued by The International Nickel Co., Inc., 67 Wall street, New York.

BEARINGS — New type of precision oil film bearings developed by The Fast Bearing Co., Hampden avenue and 23rd street, Baltimore, Md., is described in a booklet issued by the company. Specifications are included.

BEARINGS—The cause of bearing failure, methods of detecting faulty bearings and the manner in which bearing troubles may be overcome are covered in an illustrated booklet prepared by Federal-Mogul Corp., Detroit, Mich. "Engine Bearing Service Manual" is the title.

CHAINS — The Morse Chain Co., Ithaca, N. Y., has released its 1937 silent chain engineering data book which includes horsepower tables, explanations of different chain types and their applications, sprocket data, chain cases and special methods of oiling.

CHAINS — Catalog RD on Renold stock roller chain drives has just been issued by Boston Gear Works, Inc., North Quincy, Mass. It is divided into three sections: Chain drives, chain drives with oil bath chaincases, and accessories.

CONTROLS — Tri-Ply thermostatic metals, consisting of three layers of metals fused together, are described in a booklet of Laminated Metals Corp., 775 Eddy street, Providence, R. I.

CONTROLS — An 8-page bulletin on the new model 1101 Flame-otrol, a gas burner safety device to prevent explosions, has been issued by Wheelco Instruments Co., 1929 South Halsted street, Chicago. The bulletin contains many typical applications and construction diagrams.

CONTROLS (ELECTRICAL)—A new line of switches recently introduced by The National Acme Co., Cleveland, is described in a four-page bulletin issued by the company.

CONTROLS (ELECTRICAL) — Details of an automatic-discharge type magnet controller are described in a pamphlet released by The Electric Controller & Mfg. Co., Cleveland, O.

CONTROLS (ELECTRICAL) — Bulletin 500, released by Durakool, Inc., Elkhart, Ind., describes a mercury switch recently developed. General operating characteristics and application data concerning the switch are given in bulletin 501.

COUPLINGS — Construction details, applications, specifications and prices of bronze seat pipe unions are given in a catalog issued by E. M. Dart Mfg. Co., Providence, R. I.

COUPLINGS — Construction details, specifications

DESIGN—Engineered by experienced men, with many years of training in meeting the problems of GEAR manufacturing.

MATERIALS—Selected after a most careful study of the requirements of job to be done.

PLANT—Manufactured in a most completely equipped and versatile GEAR producing plant.

TYPE OF GEAR—We make all types of gears—and have had almost 50 years' experience in GEAR cutting and generating.

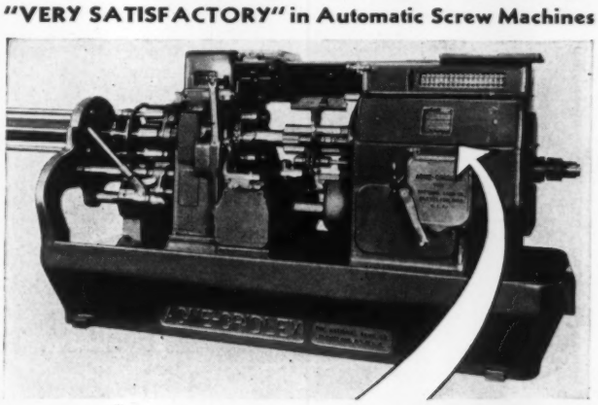
TESTING—Our testing department is competently manned, with the latest testing devices.

RESULT—Smooth meshing gears—yet very powerful—minimizing your production problem.

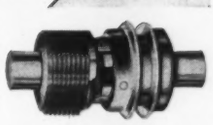
D. O. JAMES MANUFACTURING COMPANY
1120 W. MONROE STREET • CHICAGO, ILLINOIS
ESTABLISHED 1888

PULLMORE CLUTCHES

"VERY SATISFACTORY" in Automatic Screw Machines



The National Acme Company uses single type Pullmore Clutches, running in oil, in their new Model "R" automatic screw machines. From experience they state, "Pullmore Clutches have been found very satisfactory under actual operating conditions, even under severe load." Pullmore Clutches are readily adapted to design requirements, easy to adjust, have ample take-up for long periods of service. Engineers, designers and others responsible for reliable, low-cost power transmission and control are invited to test Pullmore Clutches.

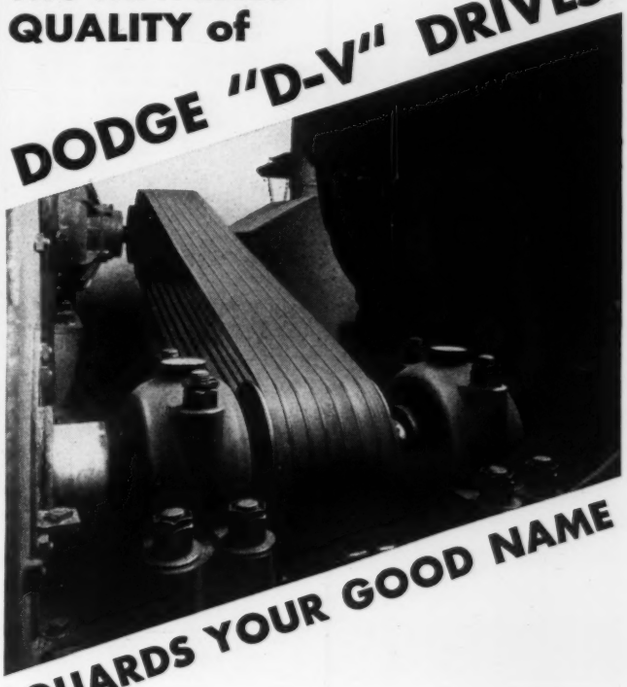


Pullmore Clutches are made in single and double types, for operation in oil or dry, in capacities up to 75 h.p.

Send for
NEW Booklet

ROCKFORD DRILLING MACHINE DIVISION
Borg-Warner Corporation, 304 Catherine Street, Rockford, Illinois
Sold by MORSE CHAIN CO., Ithaca, N. Y. With offices in principal cities

The MATCHED QUALITY of DODGE "D-V" DRIVES



GUARDS YOUR GOOD NAME

Dodge "D-V" Drives have that perfectly matched quality which insures efficient power transmission. Both sheave and belt function in perfect harmony—transmitting full power continuously and insuring against costly power loss between source and driven machine whether individually or group driven. There's a Dodge "D-V" Drive for every service. Specify Dodge "D-V" Drives on the machinery which you design.

NEW!
The third edition of Catalogue D-30 Jr., describing Dodge Power Transmitting Equipment is now available. Copy will be sent on request.

THE Right DRIVE FOR EVERY JOB

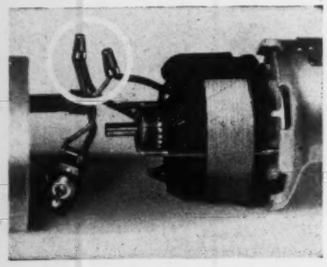
DODGE MANUFACTURING CORPORATION
MISHAWAKA, INDIANA, U. S. A.

DODGE
MISHAWAKA
THERE IS ADDED VALUE IN THE NAME DODGE

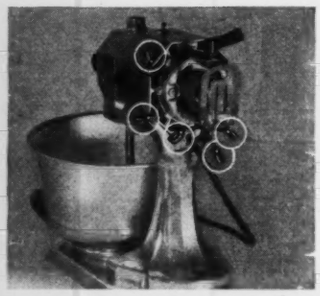
THEY STEP-DOWN COSTS . . . STEP-UP PRODUCTION!

IDEAL WIRE CONNECTORS Solderless Tapeless

Stronger Mechanically — Better Electrically



A *strong*, dependable electric wire-joint that you can count on. Reduces material cost, application time and labor. Leading manufacturers have standardized on their use.



Require no tools . . . just thread on with the fingers.

Unaffected by heat, cold or moisture.

Fully approved — listed by Underwriters' Laboratories.

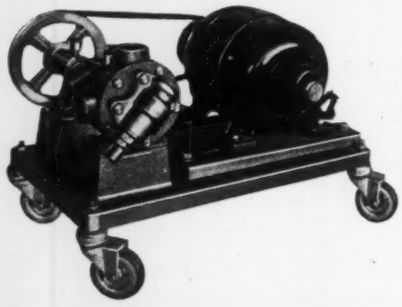
Send for free samples

LEADING MANUFACTURERS HAVE STANDARDIZED!

IDEAL COMMUTATOR DRESSER COMPANY

1059 Park Avenue Sycamore, Illinois

VIKING FEATURES



That Speak for Themselves!

- Self-Priming
- Positive discharge
- Only two moving parts
- Low Power consumption
- Long, dependable life
- Handles any clean, heavy or light liquid

Get your complete story of Viking today. Write for bulletins and prices.

VIKING PUMP CO.

CEDAR FALLS, IOWA

and applications of a new type of flexible coupling are included in a pamphlet prepared by T. L. Smith Co., 2835 N. 32nd street, Milwaukee, Wis.

FINISHES—Product summary giving the properties of a cellulose type, air-drying, flexible lacquer enamel is contained in leaflet No. 5900 issued by Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J., Another leaflet released by the company describes a chip-proof, black flexible lacquer enamel called "Blue Knight Blax." Samples of both these products are supplied with the leaflets.

FINISHES—First comprehensive laboratory report on the characteristics and applications of Syan Blue B, a product of the first new blue pigment in more than a century, is being distributed by Ault & Wiborg Corp., New York. The report contains the results of tests and studies carried on for nearly two years in the Research Laboratories of Interchemical Corp., parent company of Ault & Wiborg.

FINISHES — Two bulletins released by Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J., tell of a new buffing lacquer No. 950 which resists discoloration by sunlight and buffs to a high luster, and a flexible silver lacquer No. 5985 which is an air-drying product for blanking, printing or lithographing without chipping.

HYDRAULIC EQUIPMENT—Catalog No. H-37 released by The Tomkins-Johnson Co., 617 North Mechanic street, Jackson, Mich., covers hydraulic cylinders, power units, special equipment and engineering data. Another catalog, No. 36, issued by the company describes air and hydraulic cylinders, operating valves, chucks and special equipment.

INSTRUMENTS — Meters, controls and recorders handled by the J. L. Vergilio Co., 942 Prospect avenue, Cleveland, are described and illustrated in a folder recently issued by the company.

LUBRICATING EQUIPMENT — Over 1,000 styles and sizes of oil cups, oil and grease seals, etc., are listed and described in a new catalog of Gits Bros. Mfg. Co., 1861 S. Kilbourn avenue, Chicago.

MOTORS — Practically every commercial type of electric motor is described in a 60-page booklet issued by The Louis Allis Co., Milwaukee, Wis. Construction features, applications of various types and characteristics of different motors are included.

SPEED REDUCERS — Applications, design details and complete specifications of a wide variety of speed reducer types are covered in a 72-page catalog of Foote Gear Works, 1301 S. Cicero avenue, Cicero, Ill.

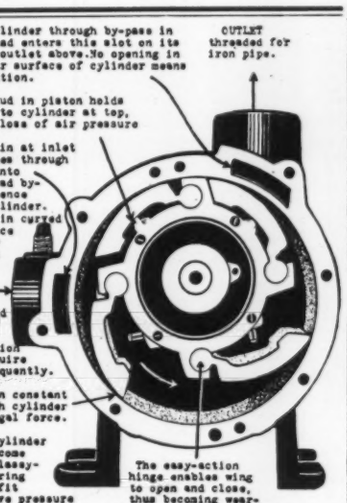
STEELS—"Fine Steels by Ludlum" is the title of a 145-page booklet issued by Ludlum Steel Co., Watervliet, N. Y., containing a number of new charts, conversion tables and other useful information. Included are a tool steel finder showing how to select the correct steel for a particular job, and a stainless finder accompanied by a table showing resistance of different grades of stainless steel.

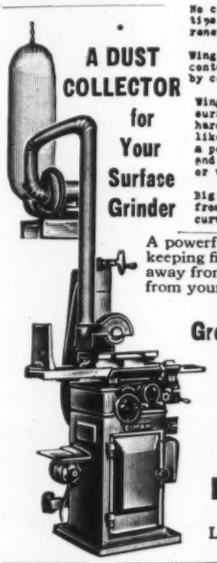
WELDED PARTS AND EQUIPMENT—Latest weld symbols are contained in the revised drafting room chart brought out by Lincoln Electric Co., Cleveland. All data necessary for producing welded designs are featured in concise ready-reference form. The chart is suitable for blueprinting.

They Take Up Their Own Wear

by the action of centrifugal force.
LEIMAN BROS. PATENTED
Rotary Positive Blowers
and
Vacuum Pumps

Powerful Efficient and Noiseless. Used for paper feeding and handling, bottle filling, gas and oil furnaces, agitation and hundreds of other uses.


Air from cylinder through by-pass in cylinder head enters this slot on its way to the outlet above. No opening in curved inner surface of cylinder means quiet operation.
OUTLET threaded for iron pipe.
Enclosed stud in piston holds wing close to cylinder at top, preventing loss of air pressure or vacuum.
Air coming in at inlet at side comes through this slot into cylinder head by-pass and thence into the cylinder. No opening in curved inner surface of cylinder means quiet operation.
INLET threaded for standard iron pipe.
No composition tips to require renewal frequently.
Wing kept in constant contact with cylinder by centrifugal force.
Wing and cylinder surface become hard and glassy-like, insuring a perfect fit and positive pressure or vacuum.
Big air space resulting from small piston and curved wings.
The easy-action hinge enables wing to open and close, thus becoming wear-compensating by the action of centrifugal force.



A DUST COLLECTOR for Your Surface Grinder

A powerful apparatus for keeping fine grinding dust away from your work and from your own lungs.

It's a Great Protection Against Lung Dust Diseases

Get the free information.

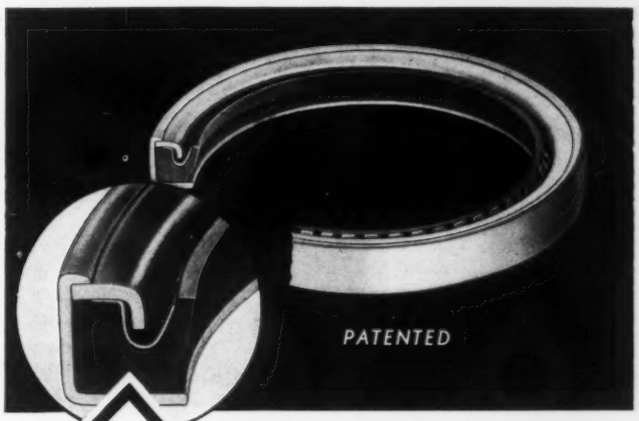
Machine Design Can Be Greatly Helped

by using air movement instead of mechanical devices. Consult with our experienced engineers about air pumps and their uses

LEIMAN BROS. PATENTED
Rotary Air Pumps

are standard equipment on many automatic machines.

LEIMAN BROS., INC.
177 Christie Street, Newark, N. J.
LEIMAN BROS. New York Co., 23P Walker St.
Makers of Good Machinery for 50 Years.



DENSE TOUGH RESILIENT

FOR SUPERIOR OIL SEAL PERFORMANCE

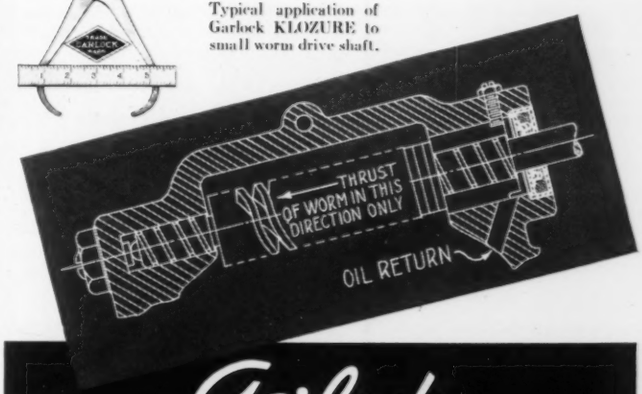
The special GARLOCK compound of which the KLOZURE sealing member is made is dense, resilient and non-abrasive—*resists oil and heat.* And it's tough and durable—*to withstand long use.*

The GARLOCK KLOZURE is simple in construction. Performance is uniform, dependable. Complete range of sizes. Write for catalog.

THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.

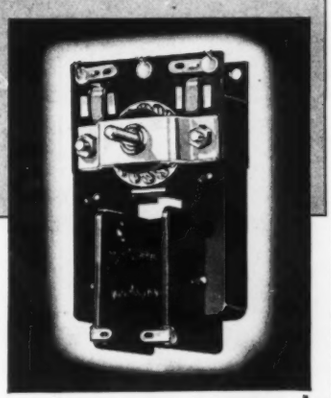
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Typical application of Garlock KLOZURE to small worm drive shaft.



Garlock
KLOZURE

A MINIATURE REVERSIBLE *Powerplant*



We Wish to Announce to Radio and Design Engineers that we have developed a reversible motor that will meet your most exacting specifications.

Designed in accordance with Underwriters' requirements, this motor incorporates features found in no other motors of its type.

Reversal is easily accomplished by a simple control switch in a low power circuit.

Long and trouble-free life is assured by use of perfectly straight shafts, centerless ground to production tolerances of .00025 inch, journaled in graphited bronze bearings surrounded by a large oil reservoir.

Both unidirectional and reversible styles are immediately available from stock.

Quotations on motors in quantity lots will be made on inquiry to

THE ALLIANCE MFG. CO., ALLIANCE, O.

Business and Sales Briefs . . . . . .

CONSOLIDATION of all plastics activities of the General Electric Co., has been made, with offices at Pittsfield, Mass. The company's construction materials sales division at Bridgeport will be relieved of the responsibility of plastic sales. G. H. Shill has been appointed manager of the plastics department, and K. W. Nelson, formerly manager of automotive product sales, has been named sales manager of the plastics department. Headquarters of the department will be located at 1 Plastics avenue, Pittsfield, Mass.

* * *

Change of address has recently been announced by C. F. Pease Co., Chicago, to 2601 West Irving Park road.

* * *

J. P. Boore has become assistant general sales manager of Babcock & Wilcox Tube Co., Beaver Falls, Pa.

* * *

Mercoid Corp., Chicago, maker of automatic controls, has opened a new office at 1035 Cathedral street, Baltimore, with John Jex Jr., in charge.

* * *

Harnischfeger Corp., Milwaukee, has recently announced the appointment of C. Sam Swanson as the new P & H representative for the entire state of Michigan, handling the sales of P & H motors and generators. He will be located at 1702 Kale building, Detroit.

* * *

It has recently been announced that the Lincoln Electric Co., Cleveland, is building a 200,000 square-foot all-welded rigid frame addition to the Cleveland factory.

* * *

Lincoln Electric Co., Cleveland, has announced the opening of a new sales engineering office at Dayton, O., in charge of R. P. Sharer. The new office will be located at 1508 Watervliet avenue.

* * *

Formerly assistant sales manager, Goodyear Tire & Rubber Co., Akron, O., Joseph E. Mayl has been appointed vice president of California Goodyear Co. W. A. Hazlett, sales manager western division, Los Angeles, will become director of the Goodyear plant in Wolverhampton, England.

* * *

R. G. Dickens has been placed in charge of sales and services of all types of clutches in the Chicago district for Hilliard Corp., Elmira, N. Y. Mr. Dickens for 20 years prior to his transfer to Chicago, was chief clutch engineer at the Elmira plant. His office is at 201 North Wells street.

* * *

Previously sales engineer of the Union Switch & Signal Co., with headquarters in New York, L. C. Ritterbush has been appointed assistant district manager, with the same headquarters. C. M. Wheeler, sales engineer of the company, with offices at Swissvale, Pa.,

You can't bust this one

Fig. 509

In actual test, we blind tapped a hole in this piece of steel. An "UNBRAKO" was screwed into it and forced through the bottom. The steel split three ways, yet the "UNBRAKO" didn't show a scratch.

THAT'S STRENGTH — when any screw will do that and come out undamaged! That's strength which you can use to meet the hazards of even ordinary service; it's a demonstration of the extra toughness that withstands severest strains.

Send for a sample and just try to break it, yourself. Give it a fair test. Then, switch to "UNBRAKOS" where you can't afford failures!

Catalog, upon request.

UNBRAKO

SQUARE HEAD SET SCREW

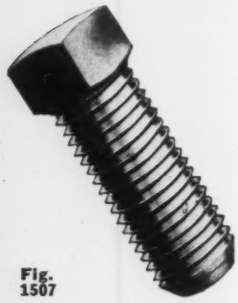


Fig. 1507

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

BOX 102

BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO

has become assistant district manager. He will continue working out of the Swissvale office.

* * *

Harvey T. Harrison has been made sales manager of Duraloy Co., Scottdale, Pa.

* * *

F. C. Ritner has been made assistant to the president, Carboloy Co. Inc., Detroit, being in charge of special wear resistant applications, new developments and special products. T. D. MacLafferty, previously identified with the Detroit office of General Electric Co., has been named assistant to the general sales manager of Carboloy, while H. C. Stone has been transferred from the Newark, N. J., office of the company to New York.

* * *

Momsen-Dunnegan-Ryan Co., El Paso, Tex., has been named distributor of Enduro stainless steel for Republic Steel Corp., Cleveland.

* * *

Formerly with the sales department of the Philadelphia office of American Engineering Co., Simeon Jester Jr., has been transferred to the Chicago office of the company. He will supervise the western Hele-Shaw pump and Lo-Hed hoist agents as well as being responsible for direct sales.

* * *

W. H. Blackmer has accepted the vice presidency and general managership of Packless Metal Products Corp., 37-14 Twenty-ninth street, Long Island City, N. Y., manufacturers of seamless flexible metal hose, packless fittings and other metal products. He resigned as sales manager of the Laminated Shim Co. Inc., Long Island City, N. Y.

* * *

In order to provide room for the company's growing business, Haynes Stellite Co., Harrison and Lindsay streets, Kokomo, Ind., has announced plans for the construction of a new building, calling for a new two-story office building and remodeling present offices into a recreation center. This new structure is the first of several contemplated.

* * *

Opening of a Detroit sales and engineering office, located in the Curtis building, 2844 West Grand boulevard, has been announced by Mathews Conveyer Co., Ellwood City, Pa.

* * *

C. S. Munson, vice president has been elected president of Air Reduction Co. Inc., New York, succeeding C. E. Adams, elected chairman and in general charge of all operations of the company.

* * *

Appointment has recently been announced of David C. Babcock, 863 Southfield road, Birmingham, Mich., as representative in the Michigan territory for Kropp Forge Co., Chicago, makers of flanges and drop and flat die forgings.

* * *

Formerly special sales representative in the Kansas City territory for American Rolling Mill Co., Middletown, O., Marvin Marsh has been named manager of the company's newly-created district office at 7100 Roberts street, Kansas City, Mo.

We Defy You

to design a machine that can shake one of these nuts loose--

A pretty broad challenge—but we know it can't be met, for Vibration just cannot loosen an "Unshako", once it has been put in place. Yet there's not the slightest difficulty in removing one of these nuts with an ordinary wrench.

"Unshako" has been proven in actual service tests in almost every type of industry where vibration has been most severe. In every case the ingenious built-in locking ring has never failed to hold it tight.

Fill in and mail the coupon—get the complete story about "Unshako", the nut that can't shake loose.

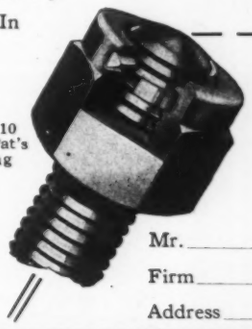


Fig. 1510 Pat'd&Pat's Pending

UNSHAKO

The Nut That Can't Shake Loose

STANDARD PRESSED STEEL CO.

BRANCHES BOSTON DETROIT INDIANAPOLIS

JENKINTOWN, PENNA.

Box 102

BRANCHES CHICAGO ST. LOUIS SAN FRANCISCO

Standard Pressed Steel Co.
Box 102, Jenkintown, Pa.

I want to hear more about "The Nut that won't shake loose". Send me full details.

Mr. _____ Title _____

Firm _____

Address _____